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ANNALS OF SURGERY

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ANNALS OF SURGERY

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ORIGINAL MEMOIRS.

THE PARATHYROID GLANDULES. THEIR BLOOD SUPPLY, AND THEIR PRESERVATION IN OPERATION UPON THE THYROID GLAND.

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AND

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THE BLOOD SUPPLY OF THE HUMAN PARATHYROID GLANDULES. HERBERT M. EVANS. The vascular injections and studies herein reported were made to determine accurately the exact source and position of the blood supply to the parathyroid glands in man. Another aim, that of knowing more of the angiology of the parathyroid gland itself, was also served, but this subject will be reported separately at a later date. I would here express my indebtedness to Professor Halsted at whose suggestion the problem was undertaken, to Professor Mall in whose laboratory the injections were made, to Professor W. G. MacCallum, Dr. H. E. Helmholtz and especially Dr. Marshall Fabyan who have kindly given me many opportunities to secure fresh human material, and to Mr. Broedel whose advice I found invaluable in the execution of the drawings.

Methods.—Recent studies in the finer anatomy and histology of mammals have shown many distinct differences so that it would be no longer justifiable to assume that the findings in the dog, for example, must be identical with those in man. Such a contention is especially strengthened in this particular case by the variation in the size and position of the parathyroid bodies in the animals which have thus far been investigated. With a full realization of this, all of the present work was done on human material. Very different circulatory relations than are here reported may be found in all those animals in which the parathyroid glands are imbedded in the thyroid. In the majority of cases the specimen was secured a few hours after death, the entire neck organs being removed en masse. The upper and lower poles of each lateral lobe of the thyroid were then carefully dissected sufficiently to identify the superior and inferior vessels in each case. In most instances, the superior arteries were ligated and the injection mass delivered through the inferior vessels, but in several cases the upper arteries were injected in addition. Though anastomoses generally permitted a partial injection of the opposite side, the two sides were always separately injected. Mercuric sulphide (vermilion) granules in a twenty per cent. gelatin solution were most often used as an injection mass and gave a splendid arterial injection which when long-continued could be made to invade the capillary bed. In several cases, the veins were filled with ultramarine blue and in still others the arteries were injected with india ink, which enters the capillaries with great facility. The entire specimen was immediately cooled in running water and a preliminary dissection made to locate the parathyroid glands. This seemed wise inasmuch as the detection of these glandules was easier in fresh material, in which the natural brownish color was retained, than in specimens in which they were blanched by the preserving fluid. A simple sketch of the position of the parathyroids was then made to be used in identifying them in the final dissection. The specimen was placed in a ten per cent. formalin solution for twenty-four hours, after which the tissues were sufficiently preserved to permit a careful dissection to be

made. Such dissections were accurately charted. Generally the parathyroid glands were ultimately removed, dehydrated in alcohols, and cleared in creosote for further study.

Observations.—Few studies of this region based on actual vascular injections have been made. However, D. A. Welsh,¹ whose excellent paper appeared in 1898, used the injection method. It is unfortunate that no figures of the vascular relations accompanied his study.

One of the first facts which appears after a satisfactory injection is that a special tiny parathyroid artery supplies this gland in every case. This artery may arise from one of the glandular, the muscular, or the œsophageal branches of the inferior thyroid artery, but wherever its origin, it can be seen definitely to supply the parathyroid gland and it alone. One may sometimes see one or two smaller arteries accompanying the parathyroid vessel, but they supply the small fat mass which often surrounds the parathyroid or lies on either side of it; my injections have never demonstrated more than one parathyroid vessel proper, and this enters a distinct hilus in the gland. Though practically all previous studies have not shown any real embedding of the human parathyroid in the tissue of the thyroid, the connective tissue envelope which surrounds the latter gland often appears to split to enclose the parathyroid. It was interesting, then, to observe what vascular connections existed between the capsule of the larger and the smaller glands. Complete injections have uniformly shown only the scantiest blood supply to this connective tissue investment. It usually consists of a few minute vessels, for the most part capillaries. These are seldom seen to be in any relation with the parathyroid glands and never to be connected with the vascular system of the latter, which is always from the parathyroid arteries. This fact was more striking when observed in a rather unique case in which I found the parathyroids so deeply set in the surface of the thyroid that their surface was barely level with that of the larger gland. Here also there was

¹ Welsh, D. A., Jour. of Anat. and Physiol., 1898.

a definite independence of the vascular system of the parathyroid from that of its immediate surroundings. It is thus quite unlikely, even if not inconceivable that the true capsular vessels of the thyroid could nourish the parathyroids and in those cases in which the lower parathyroids lie below the lower pole of the thyroid, it is all the more improbable.

In practically every case studied, the lower parathyroid artery came from a prominent branch of the inferior thyroid artery. Ten entire specimens were found suitable for accurate plotting. This would ordinarily give twenty opportunities for examining the inferior parathyroid artery, but since the gland was not found in one instance, the actual number of observations was nineteen. In six instances the inferior parathyroid gland was clearly below the lower margin of the thyroid, and the parathyroid artery in these cases coursed as a distinct, usually unbranched, vessel to the hilus of the glandule. The findings of others would indicate that so great a proportion of these cases is probably a unique experience. In such cases, the parathyroid artery has measured between two and three centimeters in length; in all other cases its course is seldom in excess of four or five millimeters.

The upper parathyroid gland invariably has a short artery of supply which may arise from one of the main branches of the inferior thyroid or from an anastomosing ramus joining the superior and inferior thyroid arteries. A very prominent anastomosing channel was found along the posterior margin of the lateral thyroid lobe in eight of twenty instances and in these cases the superior parathyroid artery was a short branch from this channel. Most often, however, the angle at which the parathyroid vessel came off from its parent trunk suggested strongly that its blood stream was usually from the inferior source.

The conditions found thus varied somewhat, but with the constant features just emphasized. The special picture presented will depend to a considerable extent on the position of the parathyroids; and using this as a sort of basis of classification three common types may be specified. Figures 1 and 2

illustrate two varieties of what may be called the first type. Here the upper parathyroid lies along the posterior border of the lateral lobe of the thyroid somewhat above the mid-point between the upper and lower "poles"; the lower glandule lies near the lower thyroid margin or pole. It is not unlikely that this particular arrangement will be found occurring most often in a large series of cases. In Fig. 1, the lower para-

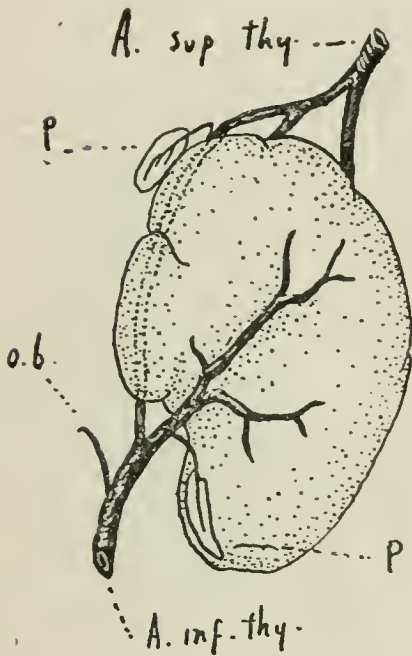


Fig. 1.

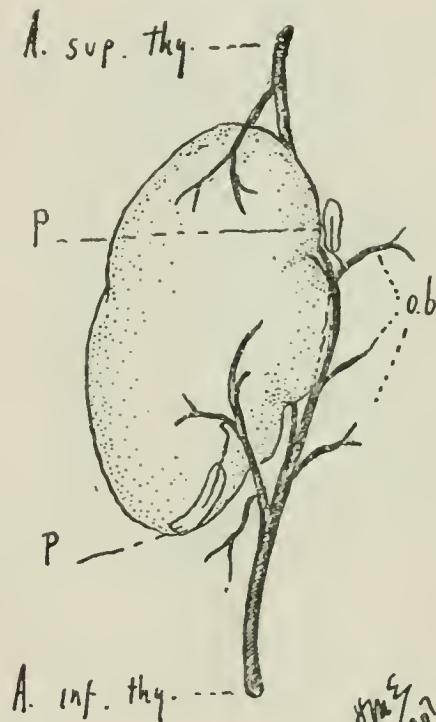


Fig. 2.

thyroid artery is seen to arise from the prominent lateral branch of the inferior thyroid artery which supplies most of the outer surface of the lateral thyroid lobe. The upper parathyroid artery here arises from the strong anastomosing channel between the upper and lower thyroid vessels which courses along the posterior border of the lateral lobe. In Fig. 2, the lower little artery comes from one of the lateral glandular rami of

the inferior thyroid, while the upper one happens to be a branch of the uppermost œsophageal ramus.

Figs. 3 and 4 will illustrate a type but little removed from that just discussed, but one in which the parathyroids are rather symmetrically disposed, the one above, the other below the mid-point between the thyroid poles. The condition shown

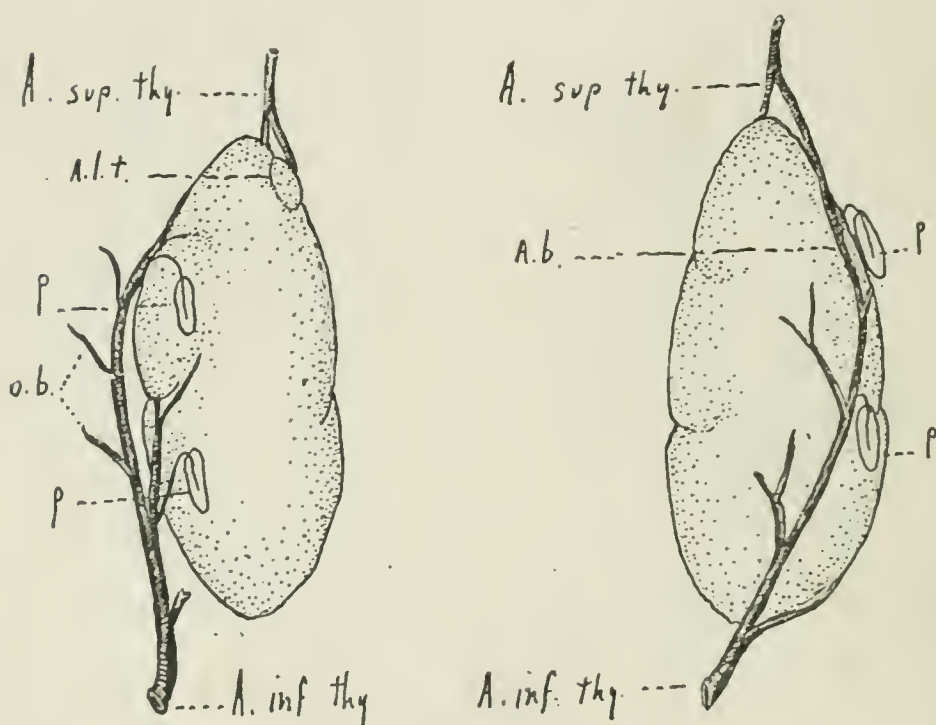


Fig. 3.

Fig. 4.

in Fig. 4 is interesting since here both parathyroid vessels came from the same large branch of the inferior thyroid, which in this case communicated with the superior thyroid artery.

In the third type, shown in the remaining two figures (5 and 6), is depicted the arrangement seen in those cases in which the lower gland is appreciably below the lower margin

of the thyroid. Here it is not unusual to find a relatively long parathyroid artery.

Various other modifications in the exact plan of blood supply were found, but, in general, the figures given illustrate the chief conditions.

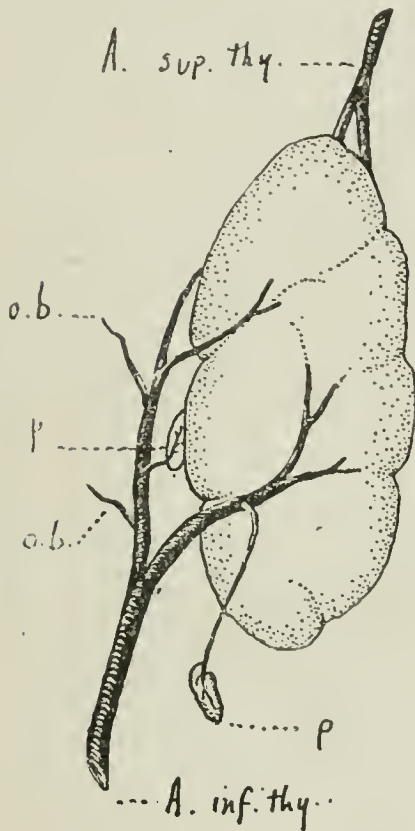


Fig. 5.

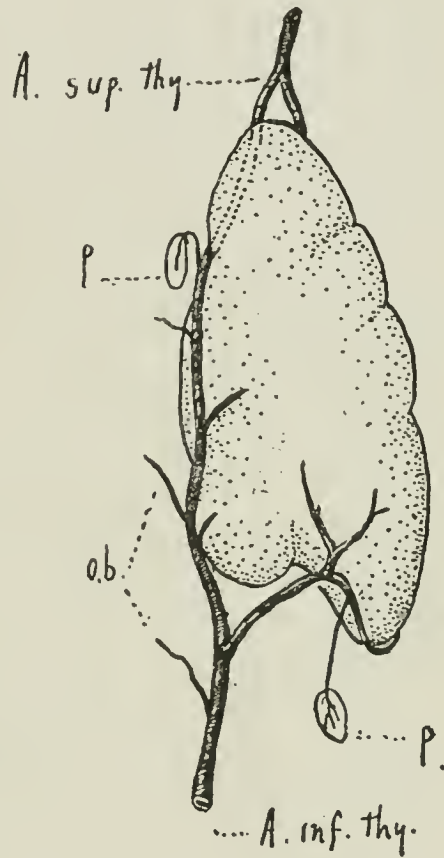


Fig. 6.

It is without the purpose of this communication to follow the behavior of the parathyroid artery after it enters the glandular hilus, but it may be said here that, in general, this vessel pursues a central course, giving off obliquely directed branches which ramify peripherally, eventually giving origin to capillaries. This picture may be seen beautifully in cleared specimens of the glandule and, it may be pointed out, is in

contrast to the scheme of circulation which obtains in the case of the thyroid gland.

The chief facts brought forward in the present report may be summarized as follows :

1. The parathyroid glands are always supplied by definite parathyroid arteries which enter them in each case at the hilus.

2. The parathyroid arteries, superior and inferior, usually arise from the inferior thyroid, but frequently they take origin from the anastomosing channel, described above, between the inferior and superior thyroid vessels. Additional types of origin of the parathyroid artery have been described and figured.

3. Few, if indeed any, direct vascular connections normally exist between the parathyroid glands and the connective tissue envelope of the thyroid.

THE PRESERVATION OF THE PARATHYROID GLANDULES IN OPERATION UPON THE THYROID LOBES. WILLIAM S. HALSTED. With our present knowledge, scant as it is, of the function of the parathyroid bodies comes not only the recognition of the necessity for their preservation but more frequent occasion for operations which imperil the vitality of these little life sustaining organs.

When tetany was believed to be due to thyroid privation the surgeon feared to operate upon both lateral lobes of the thyroid gland, having learned that the death rate from total excision of this organ was very great, and, that tetany, the chief cause of this mortality, might follow the excision of merely one lobe of the thyroid gland or ligation of two or even of one of the four thyroid arteries.

As long ago as 1889 it was discovered that dogs would survive the gradual excision of as much as thirty-one thirty seconds and of even a greater proportion of the thyroid gland provided the fraction remaining was the superior pole of either lobe. That tetany did not result was due to the fact, not surmised until the appearance of Gley's superb contributions in 1891, that the superior parathyroid body, situated in the dog very near to and usually a little above the superior pole of the

thyroid lobe had escaped destruction by this method of piecemeal excision, from below upwards, of the thyroid gland. In man, however, with gradual, piecemeal amputation from below upwards of the thyroid lobes destruction of all of the four parathyroid glandules would, as a rule, already be accomplished with the removal of the lower two thirds, approximately, of each lateral lobe: vid. figs. 2, 3 and 5. But even before it was ascertained that the parathyroid bodies had any function whatever a long series of happy accidents demonstrated that total excision of the thyroid gland might, in man, be survived in about fifty per cent. of the cases; in many instances, moreover, there was entire absence of symptoms of thyroid as well as of parathyroid insufficiency.

Only now that the function of the thyroid gland and the parathyroid glandules may no longer be so confounded, are we in a position to determine the amount of each of these organs likely to be necessary in a given case to prevent the occurrence of symptoms of deficiency of either. And even before this has been more definitely determined surgeons are justified in proceeding with greater intrepidity in operation involving the sacrifice of the thyroid and threatening the destruction of the parathyroid glands, believing that the symptoms of privation of each may be mitigated or entirely negatived by the administration in some form of the nucleoproteids or whatever substances are lacking.²

In the mean time our plan of operating not only for the exophthalmic or hypertrophic forms but also for the colloid, degenerative or atrophic varieties of goitre may be modified in conformity to our recently acquired knowledge of the function of the glandulæ parathyreoideæ. In place of the unilateral operation, heretofore almost exclusively practiced in cases of colloid or other nonhypertrophic varieties of goitre, a bilateral

² The patient suffering from hypoparathyreosis whose history is reported in the July number of the American Journal of Medical Sciences is rapidly being restored to health by the administration, hypodermically, of the nucleoproteids of the parathyroid glands of beeves, supplied me, most kindly, by Prof. S. P. Beebe, of Cornell, N. Y.

operation might be substituted in some cases; and in the hypertrophic goitres, the one lobe should be so operated upon, that, in case of need, the other may be subsequently attacked without danger of parathyroid privation. Even in the absence of the existing vital reasons which contraindicate the sacrifice of a single parathyroid glandule, the fact that these little organs perform some highly important function is sufficient reason for the endeavor to preserve all of them.

Although for more than a decennium we have known that operative tetany is due to loss of parathyroid tissue more cases of this affection have followed operation during this time than in the preceding quarter century; and, furthermore, at the hands of the operators most experienced in the surgery of the thyroid gland.

Dr. MacCallum, who has carefully studied the operative material from about eighty cases of exophthalmic goitre operated upon by the writer, reports having found in perhaps seven instances one parathyroid with the excised lobe. During the past two years this glandule has only twice, I believe, been excised by me with the thyroid lobe. Nevertheless it is quite certain that in most instances of complete excision of one thyroid lobe as reported by surgeons the world over both parathyroid glandules of the operated side have been sacrificed whether the trunks of the thyroid arteries were tied at some distance from the gland or the ultimate branches of distribution at their points of entrance into the thyroid lobe; and even when that portion of the thyroid in which the parathyroid glandules are quite uniformly found has been resected and left undisturbed, the latter bodies were undoubtedly often destroyed.

It is in the control of hemorrhage that we sacrifice the parathyroid glandules. But the hemorrhage must be controlled and thyroid vessels must somewhere be divided in the operation for the removal of a lobe of the thyroid gland. May they be so divided and secured as not to cut off the blood supply of the parathyroid glandules? Reply to this question is impossible without definite knowledge of the blood supply of these little bodies.

Dr. Mall did me an invaluable service in recommending Mr. Herbert M. Evans, of the class of 1908 of the Medical School of Johns Hopkins University as one particularly well equipped for making the investigations. Mr. Evans³ undertook the work with enthusiasm, being interested both in the anatomical and the surgical aspect of the problem. Upon his report, which precedes, this paper is based.

The Situation of the Parathyroid Bodies.—Their position in man is, in general, much lower than in dogs, the higher of the two glands of one side being, on the average about at the level of the junction of the upper and middle thirds of the lateral lobe of the thyroid gland. Occasionally a parathyroid is found as high as, or even above the superior pole of the thyroid gland. In one instance at the operating table I happened to find a parathyroid above the level of the superior pole of the thyroid gland. The lower of the two glandules, rarely as high as the middle of the thyroid lateral lobe, is usually not far from the lower pole, but may be several centimetres below it—even within the bony thorax. With great regularity these little epithelial bodies are situated on or very near the posterior border of the lateral lobe of the thyroid gland and more or less in line with an important landmark, the “channel” of anastomosis between the superior and inferior thyroid arteries.

The Blood Supply.—As determined by Mr. Evans each glandule has invariably its special artery which might be designated the superior and inferior parathyroid artery right and left. This little vessel surprises one by its size, being large in proportion to the organ supplied, and thus aids in the identification of the epithelial body. The parathyroid artery is particularly serviceable as a guide to the parathyroid gland when the latter is enveloped in fat. Ordinarily these glandules are quite free and, as cherries on the stem, hang from the artery which, as described by Mr. Evans, enters its “hilus.”

The usual shape of the bodies is indicated in the drawings.

³ In another communication Mr. Evans will give in greater detail the result of his study of the circulation of the parathyroid glandule.

They are ordinarily ovoid and flattish, presenting a sharpish edge which may as a rule be easily curled or folded. The surface markings which give the glandule an exceedingly fine, barely visible granular appearance are probably due to the blood vessels. Differentiation from adipose or thyroid tissue is rarely difficult unless the natural appearances have been obscured by trauma or staining.

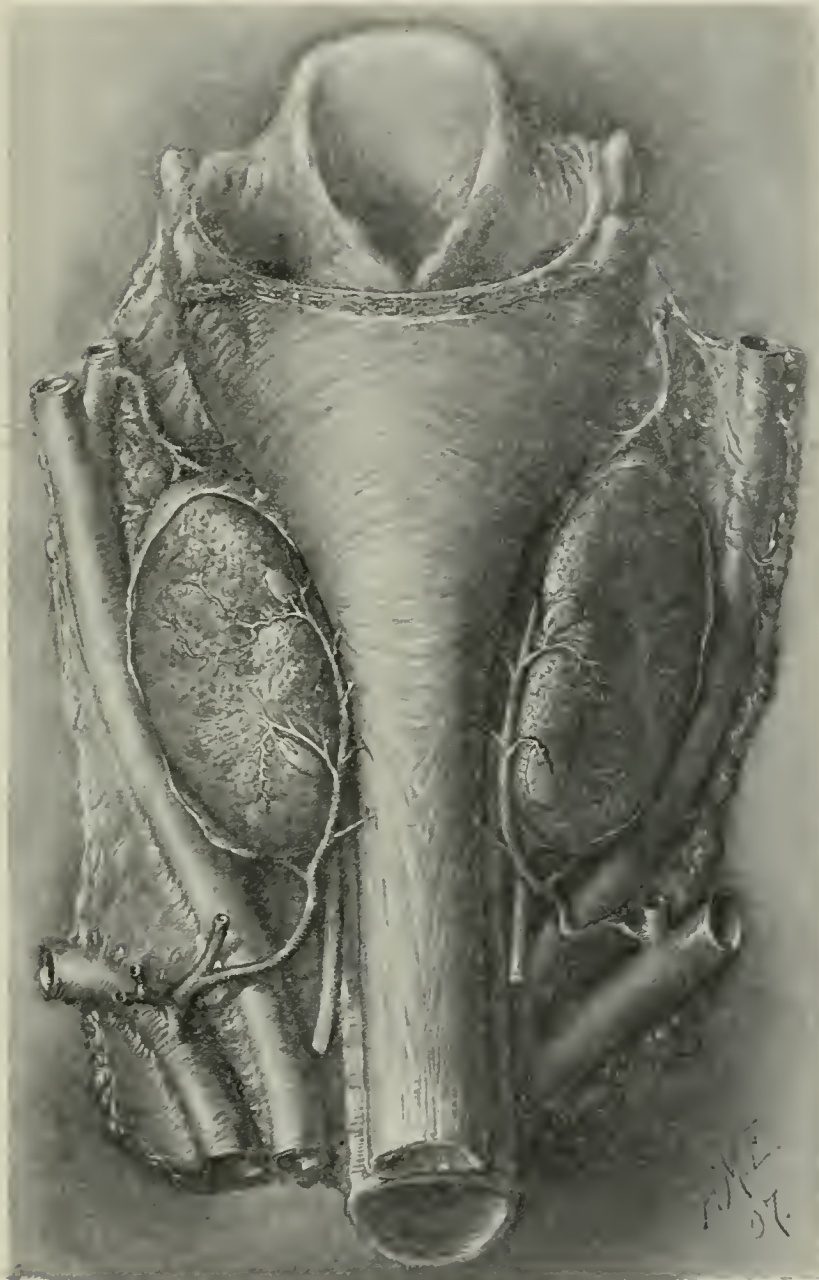
To Save the Parathyroid Glands in Performing Thyroid Lobectomy.—We have seen that from the superior and inferior thyroid the parathyroid arteries almost invariably arise, but we may assume that by the way of the œsophageal or other branches of anastomosis a number of parathyroid glands have been rescued; otherwise it would be difficult to explain the large percentage of recoveries which followed simultaneous ligation in man of all four of the thyroid arteries in the total excisions of a quarter of a century ago. It is important to note that these excisions were not undertaken for the hypertrophic forms of goitre.

Total extirpation performed in this manner in cases of Graves' disease would, perhaps, rarely fail to be followed by tetany. But it frequently happens that more than one lobe, or indeed that the greater portion of both lobes has, in two or more acts, to be removed in hypertrophy of the thyroid gland.

The "subcapsular" procedure of Dr. Chas. H. Mayo, is, I believe, correct in principle, and, with the proper observance of details, for knowledge of which we are indebted to more complete acquaintance with their vascular supply, one or perhaps both parathyroid glandules of a side may be saved. But only with the exercise of the greatest caution; for, between the point at which the branch giving off the parathyroid artery enters the thyroid lobe and the origin of the latter vessel, there may be hardly room for one fine pointed artery forceps and not space for a broader-nosed clamp, as, for example, the admirable instrument of Ochsner; and still less for two clamps.

On two occasions, recently, in the operation for exophthalmic goitre, there was not room even for the fine point of our "mosquito clamp," and twice I deliberately cut off the blood

FIG. 7.



Parathyroid Glandules.

supply of the inferior parathyroid gland seeing no alternative save preserving a portion, too considerable, of the thyroid lobe. On several occasions, operating for exophthalmic goitre, I have transplanted into the thyroid gland a parathyroid glandule which had been deprived of its blood supply.

The drawings of Mr. Evans happen to be made from specimens which do not illustrate this point particularly well; but in figures 2 and 7 the inferior parathyroid is given off from a branch of the inferior thyroid artery only a few millimetres from the point at which the latter penetrates the thyroid gland. In fig. 3, also, the inferior glandule, a centimetre or more below the inferior pole of the thyroid gland, might easily be deprived of its blood supply if its artery were not recognized in the course of the operation. There is room in this instance for the application of 2 ordinary artery clamps distal to the point of origin of the parathyroid arteriole; but it should be observed that a nicely injected, carefully dissected specimen makes plain conditions which, in the course of an operation might be overlooked. The remaining glandules of the illustrations might with care escape destruction, for their arterioles are very short and arise in the main from the anastomotic channel or quite near to this vessel.

The term "subcapsular" expresses the operation of ultra-ligation very well, it seems to me, and I find it exceedingly convenient. It may be objected that there is normally no demonstrable capsule underneath or in the plane of the blood vessels of the thyroid gland, but the term proposed by Mayo is, nevertheless, not confusing and will not easily be relinquished. As a matter of fact there is not infrequently in cases of goitre, an intimate capsule enmeshing the vessels, which can not only be seen during the dissection but demonstrated thereafter.

The Operation of Ultra-ligation in Exophthalmic Goitre.
—The operation of ultra-ligation or ligation beyond the origin of the parathyroid arterioles is quite simple if properly performed, but may prove very difficult, if not. The skin incision is usually made to correspond with one of the transverse lines of the neck, its length depending upon the size of the goitre

and upon the height of the superior pole of the thyroid. For a better cosmetic effect, in the case of women, we often determine the precise line for the incision with the patient in a sitting posture, consulting her as to the fall of the necklaces which she wears with evening dress. If the line is prescribed in the recumbent position the scar may fall too low. The platysma muscle, carefully reflected upwards in the skin flap, may be divided at a slightly higher level than the skin. In the dissection of this flap and indeed throughout the operation the injury to veins should be avoided as studiously as possible. A vertical, mid-line incision through the fascia is carried only deep enough to enable one to raise the sterno-hyoid and omo-hyoid muscles. It is an excellent suggestion of Chas. Mayo's to divide these muscles near their hyoid insertion, and between clamps which are not removed until it becomes necessary to do so, to permit the placing of the muscle suture.

It has not been my practice, however, to include in these clamps, the sterno-thyroid muscle. I believe that one is less likely to stain the deep wound if the sterno-thyroid muscle is carefully divided by itself after the hyoid muscles have been reflected, and in such a manner as not to cause the rupture of the fine and easily torn vessels which one encounters in raising this thinly spread out, capsule-like muscle from the thyroid gland. Moreover, one cannot reflect the omo-hyoid and sterno-hyoid muscles to so high a point if the sterno-thyroid muscle is included. The latter muscle being well divided and the previously severed muscles forcibly reflected by means of the strong muscle-clamps, one may gently raise the thyroid lobe from its bed on a spatula-like knife handle carefully insinuated between the delicate blood vessels just coming into view.

Contrary to the universal custom, I do not as a rule, complete at this moment the full delivery of the entire gland, for fear of soiling, but grasp very firmly between thumb and finger the superior pole and pull it forwards and towards the mid-line far enough to make the ultra-ligation of the superior thyroid vessels perfectly easy. Attempts to completely dislocate the entire gland or the inferior pole in this manner at this

stage of the operation may cause the rupture of some delicate blood vessels and consequent staining of the field containing the parathyroid glandules. But, if judiciously done in the manner described, the superior pole may be fearlessly grasped, because at this horizontal level there are no vessels behind the superior pole likely to be torn. When the superior thyroid vessels have been safely passed by the thumb or finger one may proceed with considerable roughness and without fear of hemorrhage to dislocate even the highest and deepest superior pole.

This grasp of the upper portion of the lobe putting on stretch the superior thyroid vessels must not be relinquished until released by the ultra-division of the finest branches distributed to the thyroid gland in the vicinity of the superior pole. The upper end being thus liberated the delivery of the entire lobe is continued, and without the tearing of the blood vessels. From this step on, throughout the operation, until the last vessel has been divided the thyroid lobe must be firmly drawn towards the opposite side, alternate relaxation and compression and undue pressure on the trachea being carefully avoided. From above downwards and from before backwards the vessels as they bind or as they present must be clamped and divided at their point of entrance into the gland, as far peripherally as possible.

Except in the case of the larger branches it is usually unnecessary to clamp the distal end of the cut vessel, hemorrhage from the gland side being prevented by the pressure exerted on the thyroid lobe by the unremitting traction towards the opposite side of the neck. By this method the recurrent laryngeal nerve, usually seen, is little endangered. In the course of the liberation of the lobe the nerve may be dragged well to the front of the trachea: of the right nerve this is particularly true. When in the immediate neighborhood of this nerve, at what might erroneously be termed the hilus of the thyroid lobe, one plunges the sharp pointed clamps into the thyroid gland, seizing the binding vessels after they have disappeared from view in its substance. When the habit is well

acquired little if any time is lost by practicing the clean, bloodless method of operating for goitre. The operation can be carefully performed in about the time required for its detailed description. For the removal of a thyroid lobe in a moderately difficult case of exophthalmic goitre, ten minutes is ample time if the experienced, skillful operator is well assisted.

I am not convinced that very light general anæsthesia with ether skillfully given by an expert anæsthetist for only fifteen or twenty minutes is less safe, even in the gravest cases, than local anæsthesia plus the prolonged operative period and its attendant nerve strain. In operations for exophthalmic goitre the general anæsthesia should be administered only by an expert.

A nurse trained in the præ- and post-operative care of cases of Graves' disease should be in charge, and the patient should have a private, quiet room. We have knowledge of no analogous disease, and of no toxæmia comparable to that which follows operation upon people afflicted with hyperthyroidism. It is therefore particularly difficult for the uninitiated to realize how critical is the condition of so many of these patients until, as a demonstration, a death has been experienced.

As so impressively pronounced by Dr. Mayo at his clinic, saturation of the patient with water must be accomplished in one way or another. The surgeon must not accept excuses that water could not be given by mouth because it hurt the patient to swallow, and not by the intestine because the guttatum injections were expelled, unless the patient is uncontrollable; in such event prompt resort to subcutaneous infusion must be had.

Chilling or Freezing the Neck Before and After Operations for Graves' Disease.—It had not occurred to me until the end of June, a few days before leaving town for the summer, that excessive cold applied to the neck in these cases, particularly after operation, might delay the processes of repair and absorption and thus bridge over the period of greatest danger, the two or three days succeeding operation. Its employment was very imperfectly tested in three instances, but in all with beneficial results, it seemed to me, although one of the patients,

desperately ill before operation, did not recover. In no instance, unfortunately did we succeed, with the inadequate appliances at our disposal, in doing much more than slightly cool the surface of the skin. In one case, 36 hours after operation, the pulse which had been steadily rising until it reached 180, dropped 30 beats per minute within one and one half hours of the application of the cold. In another, a good night's sleep, the first in weeks, seemed to be attributable to the application of cold to the neck. It is quite possible that harm rather than good might be done by ineffectually applied ice bags. They might serve as a poultice if, for example, swathed in protecting flannel, or if negligently attended to. The danger of reaction, too, must be constantly borne in mind—the reaction following either a brief or a prolonged use of the cold. Therefore no time should be lost in changing the packs; and ultimately the cold should gradually be withdrawn. I doubt the ability of the rubber ice bag to produce a degree of cold sufficient for the very ill cases; or the non-conducting rubber should, perhaps, be so thin that rents would be hardly avoidable. In some cases a degree of cold low enough almost to freeze the skin might be necessary. Possibly to be considered as a method of treatment for desperately ill cases is an unclosed wound constantly irrigated with water of the desired temperature.

I am convinced that the toxæmia is not simply due to the absorption of thyroid secretion. Otherwise might not the gravest cases of exophthalmic goitre be safely treated by total excision of the thyroid gland? It is my belief that the toxæmia incident to wound healing is badly borne by the subjects of hyperthyroidism. On several occasions, soon after thyroid lobectomy, I have seen prompt and great improvement follow the liberation of a drachm or even a few drops of reddish serum from the wound. Moreover the typical post-operative toxæmia may, it seems, follow operations of other kinds upon patients afflicted with Graves' disease. Absorption takes place continuously during the process of repair, even in wounds which are "dry" and healing throughout by first intention. Thus it

seems to me quite reasonable to hope that something, perhaps much, may be accomplished by the adequate employment of cold. The entire neck fore and back and sides, and from chin to chest might be made so cold in the serious cases as to arrest for a time, more or less completely, the process of absorption and possibly of healing.

Furthermore, if absorption from the wound is, even in a measure, responsible for the toxæmia so badly borne, the area of the wound surfaces must be a factor influencing the result; and, if so, there would be in this an indication for as small a wound as feasible in certain cases. A vertical skin incision to avoid reflection of a flap might be tested and less complete division of the muscles at their attachment to the hyoid bone might suffice for the liberation, in the manner described in this paper of the superior pole. The operation of ultra-ligation might thus be effected through a hole just large enough to permit the delivery of the lateral lobe of the thyroid gland.

TETANY PARATHYREOPRIVA: *

A CASE REPORT, WITH A BRIEF DISCUSSION OF THE DISEASE AND OF THE
PARATHYROID GLANDS.

BY EUGENE H. POOL, M.D.,

OF NEW YORK,

Attending Surgeon to the French Hospital, New York; Instructor in Surgery in Columbia
University.

THE acquisition in recent years of an anatomical knowledge of hitherto unsuspected organs, the parathyroid glands, has engendered much investigation as to the physiological rôle and pathological import of these bodies. Dependent upon such studies, interest has coincidentally centered on the subtle question as to the explanation of certain nervous manifestations which attend the removal of these structures in animals. The condition thus artificially produced appears to be of the same nature as a group of symptoms which occasionally occurs in man. These symptoms were first described by Steinheim¹ in 1830, and the name tetany was subsequently given to them by Corvisart.² Since then the same clinical picture has been repeatedly noted in association with various conditions of widely different character. For example, it has been seen to occur with severe gastro-intestinal affections, especially dilatation of the stomach, with pregnancy and the puerperal state, with some acute fevers, with various nervous diseases, and after removal of the thyroid gland.

The cause of its occurrence in most of these conditions is not understood. As a sequel, however, to thyroid operations it has been definitely ascribed to the removal of the parathyroid bodies, and in consequence has been designated by Erdheim³ tetania parathyreopriva.

Observation of a case which recently came under my care

* Read before the New York Academy of Medicine, May 2, 1907. Through the courtesy of Prof. T. M. Prudden and Prof. J. A. Blake the work for this paper was done in the Pathological and Surgical Research Laboratories of Columbia University.

gave rise to an effort to collocate the clinical features and therapeutic possibilities in this variety of tetany. To do this clearly it seems necessary to supplement such considerations with a review of the history of the subject and of the anatomy, development, and theories as to the physiological rôle of the parathyroid glandules.

Case Report.—The patient, a seamstress by occupation, is a Swiss, thirty-three years of age. She was referred to my service at the French Hospital by Dr. Fellowes Davis, in April, 1906. The significant features of her history are as follows:

In 1903, she had considerable pain in the lower part of the neck and marked dyspnœa and dysphagia. For some time previous to that there had been a large tumor in the region of the left lobe of the thyroid gland. An operation was performed in Bern, Switzerland, and a tumor on the left side of the neck was removed. This was undoubtedly the left lobe of the thyroid. For one year after the operation she was relieved of her symptoms, but during the second year the dyspnœa, dysphagia and swelling returned and increased to such an extent that operation became imperative.

Besides the features mentioned above there was nothing of importance in her history. Though in childhood a number of operations had been performed upon her eyes, the last of which was eighteen years ago, she had always enjoyed good health and had never suffered from any nervous troubles.

Physical Examination.—The woman was thin and pale, her expression anxious, breathing labored, the sternomastoids prominent. There was a slight rounded projection, about one and a half inches in diameter, just above the sternum, and a faint scar of the incision of the former operation could be seen. The mass, which reached beneath the sternum, was firm and nodular and moved with the larynx on swallowing. The examination was otherwise negative.

On March 3, 1906, I operated under ether anæsthesia and exposed the thyroid by a curved incision. In the region of the isthmus there was a round, smooth mass, about two and one-half inches in diameter, which was to a great extent bound down by cicatricial tissue; it extended downward behind the sternum and

compressed the trachea. The left lobe of the thyroid was absent. Before any tissue was removed the right lobe was thoroughly exposed and found to be of normal size, appearance, and consistency. Accordingly, the thyroid gland was clamped at the junction of the isthmus and the right lobe, and cut across as close to the tumor as possible. Before doing this it was found necessary to ligate the inferior thyroid artery which ran close to the tumor. The whole of the right lobe, except a small part which lay close to the isthmus, was left. The wound was closed with drainage.

Postoperative Course.—The healing of the wound was uneventful. On the fourth day after operation, tetanic contractures occurred in both hands, which assumed an attitude similar to that produced by stimulation of the ulnar nerve, an attitude sometimes called the accoucheur's hand, since it is the same as the position taken for making a vaginal examination. Throughout the disease this was the usual contraction of the hands. The spasm was accompanied by cramp-like pains in the hands, and occasional twitching of the facial muscles, with some neuralgic pains in the right side of the face. This condition was present whenever the patient was seen during the next twenty-four hours, when cramps in the feet and calves occurred together with forcible plantar flexion of both feet which lasted for about five minutes.

After that for about thirteen months the patient presented the typical clinical features of tetany. Of the symptoms, the most conspicuous were bilateral and symmetrical contractions of the flexor muscles of the hands, wrists, and feet (Figs. I, II and III), as previously described, preceded and accompanied by cramp-like pains in the affected muscles. To these spasms were added at times attacks of more general contractures, occasionally with cyanosis which necessitated the administration of chloroform, attacks of asthmatic breathing, of tetanic spasms of the muscles of the face, jaw, neck and back, slowness and thickness of speech, difficulty in swallowing, but apparently no dullness of mind. The skin and hair seemed unchanged beyond a slight growth of hair on the chin and upper lip. There was for several weeks marked edema of the left wrist and hand, and redness over the knuckles of this hand. Chvostek's and Trousseau's signs were present and typical almost all of the time. Thus, the facial muscles, as

a rule, contracted rapidly to mechanical irritation by tapping over the facial nerve; and by steady pressure on the nerves and vessels of the arm the usual contracture of the hand was brought on in about one-half to three minutes, sometimes with distinct fibrillary twitching over the thenar eminence. In this test, cramp-like pains regularly preceded the spasm which developed gradually and not suddenly. Contractures also resulted from making the sciatic nerve tense by holding the patient in a sitting position, so that the trunk and thighs were flexed beyond a right angle, with the legs extended; or by putting the nerves of the brachial plexus on the stretch by elevating the arm above the head with the forearm extended (extreme abduction). Figs. IV and V.) The contracted muscles were always board-like to the touch. Unfortunately, tests with the galvanic current were not made; but Dr. J. A. Booth reported on February 8, that with the faradic "even mild currents brought on tetanic contractions in both upper and lower extremities, showing a decided increased electrical excitability."

The above symptoms occurred in attacks at variable intervals. During the first six weeks and the last three months of the disease, there were from one to five attacks almost every day. The duration was from several minutes to several hours. During the intervening seven months, when the patient was not in the hospital, they were much less frequent, but prevented her from working.

About five weeks ago the attacks of typical tetanic spasms gradually ceased; the other tetanic symptoms also gradually disappeared, and Chvostek's, Trousseau's, and the other two tests mentioned above, became less marked, and now elicit no response. Moreover, the electrical tests made by Dr. Booth on April 23, showed only slightly increased galvanic irritability in nerves and muscles, the most marked being in the ulnar nerve ("Ca Cc > An Cc, 3 Ma").

Hysterical symptoms of various kinds have, however, become marked and are now striking. This is not surprising considering the prolonged sickness and the frequent use of hypnotics and other drugs. This condition, however, is improving under the care of Dr. Booth.

As regards treatment, the following were tried: various thyroid and parathyroid preparations by mouth and hypoderm-

FIG. I.



Tetanic spasm, showing flexion of wrist.

FIG- II.



Tetanic spasm, showing plantar flexion of foot and toes.

FIG. III.



Tetanic spasm showing contraction of muscles of calf.

FIG. IV A.



Method of producing a tetanic spasm in foot by stretching the sciatic nerve by means of forcible flexion of trunk on thighs. Taken immediately on sitting up, before occurrence of spasm.

FIG. IV B.



Method of producing a tetanic spasm in feet by stretching the sciatic nerve by means of forcible flexion of trunk on thighs. Taken 1½ minutes later, showing onset of spasm.

FIG. V.



Method of producing tetanic spasm of hand by stretching the brachial plexus by means of forcible abduction of arm, showing accoucheur's hand.

ically. The parathyroid material was supplied by Prof. Vassale, of Modena, by Dr. Beebe, of New York, and by Armour and Co. One saline infusion of twenty-four ounces was given, and five parathyroids were implanted subcutaneously. These were removed aseptically immediately after death from three accident cases, put at once into ascitic fluid, and implanted as soon as possible. Under general anæsthesia the implantations were made into the abdominal wall and the lobe of the ear. In the latter case a deep incision was made along the lower free margin of the lobe so as to divide it into two lips. Cocaine was not used on account of the disadvantage which might result from the infiltration of the tissues. The parathyroids, while in the ascitic fluid, were cut so as to expose two or more raw surfaces; the technique differed in this respect according to the size of the gland. The lobe of the ear seemed to present a particularly favorable site for the implantation because a perfect and permanent opposition of the implanted parathyroid and the two surfaces of the wound was readily obtained by gentle pressure produced by an appropriate dressing. All the wounds healed by primary union. The first two implantations were made on March 1; in this case the operation was finished ninety minutes after the death of the patient from whom the tissues were taken. The other three implantations were made on April 17.

The improvement which occurred about one month ago,* that is, the gradual disappearance of the true symptoms of tetany, was coincident with the repeated administration of Beebe's nucleo-proteid in large doses by hypodermic, and occurred from four to six weeks after the first implantation. No effect could be attributed to other therapeutic measures.

Historical.†—Operations for goiter were uncommon until about 1877; but since then, due largely to the impulse of Billroth and Kocher, they have progressively increased in frequency. The occurrence of tetany after such operations was first recognized by Weiss⁶ in 1880. About three years later, Kocher⁷ and Reverdin⁸ called attention to the condition since known as

* This paper was read May 2, 1907.

† Since exhaustive histories have been published several times, only a résumé is given here, and the reader is referred to such articles as those by Erdheim,³ Jeandelize,⁴ and Welsh,⁵ for a more detailed account.

cachexia strumipriva, and this was shown by Kocher to be a frequent sequel to complete thyroidectomy. The two diseases, tetany and cachexia strumipriva, were regarded for a considerable time simply as different phases of one condition which was supposed to be dependent upon insufficiency of the obscure function of the thyroid gland.

The above clinical contributions awakened a new interest in the study of the thyroid by animal experimentation, which had been carried on intermittently ever since the early thirties⁹ of the last century, but with indefinite and contradictory results.

As a result, Schiff,¹⁰ in 1884, clearly showed that certain animals, notably cats and dogs, regularly succumb to complete removal of the thyroid gland except in isolated cases which were explained on the supposition that the thyroid function was then carried on by aberrant or accessory thyroids.

In consequence of the dire effects which were thus noticed experimentally as well as clinically after complete thyroidectomy, it became a surgical mandate that part of the organ should be spared in goiter operations. This precept, which was fathered by Kocher,¹¹ has prevailed up to the present time and its practice accounts for the relative infrequency of postoperative tetany and cachexia strumipriva.

In the results of animal experimentation a perplexing inconsistency prevailed. Whereas total thyroidectomy in dogs, cats, and carnivora in general, was regularly followed by fatal tetany, in contrast to these animals, rabbits and other herbivora regularly survived the operation with no evidence of tetany, but with the development of the slower cachexia strumipriva.

The peculiar difference in the reactions of these two classes of animals to the removal of the thyroid gland was the crux which for a long time defied explanation and prevented further progress. Its ultimate solution, however, furnished the clew which resulted in rapid advances leading up to our present knowledge of the subject. The credit for this all-important step is due to Gley¹² who in 1891 called attention to the existence in the rabbit of two bodies entirely separated from the thyroid, the external parathyroids. He demonstrated that in this animal the removal of these together with the thyroid produced the same effects as complete thyroidectomy in other animals. His conclusions may be summarized as follows:

1. The removal of the thyroid alone (in the rabbit or dog), leaving the two external parathyroids, causes no tetany.

2. The removal of the two external parathyroids in the same species of animals, also causes no tetany.

3. The removal of the thyroid and the two parathyroids, at the same time or in two stages, results in tetany.

He explained incorrectly the negative effect of removing the thyroid alone (I, *supra*) by the assumption that the parathyroids which were left acted vicariously for the thyroid. Moreover, since he did not recognize the existence of the internal parathyroids, the negative results following removal of the two external ones suggested to him nothing significant.

Attention should be called to the fact that Sandstroem¹³ in 1880, eleven years before Gley's contribution, had recognized the parathyroids in man, and had described their gross anatomy and histology minutely and accurately. Apparently little notice was taken of his report, and certainly it failed to stimulate scientific research. However, the name "*glandulæ parathyroideæ*" which he applied to the organs, has been generally adopted.

While a new theory was suggested by Moussu,¹⁴ to the effect that the simultaneous ablation of the thyroid and parathyroids might possibly suppress two functions instead of one, the first practical step towards ascribing to the parathyroids an independent potency resulted from the work of Vassale and Generali¹⁵ which was published in 1896. They demonstrated that the removal of the four parathyroids, the thyroid being preserved, led to fatal tetany; while no tetany resulted from the removal of the thyroid if the parathyroids were left. These conclusions were based upon the following striking experiments:

Ten cats; total parathyroidectomy; nine dead before 11th day. In all there were characteristic symptoms of tetany.

Nine dogs; total parathyroidectomy; all dead before the 9th day. In these animals the symptoms were analogous to those of complete thyro-parathyroidectomy. Every effort was made to exclude complications, such as injuries to nerves or to the thyroid as possible causes of the fatal results.

It has been urged by numerous experimenters, among whom are Biedl,¹⁶ Walbaum,¹⁷ Vassale and Generali, that the intensity of tetany parathyreopriva stands roughly in inverse ratio to the number of healthy parathyroids retained by the animal. Thus,

in a cat the removal of three parathyroids has been said to result generally in fatal tetany; of two, in lighter tetany; of one, in no tetany. But this rule is certainly far from absolute, for sometimes the presence of one parathyroid is sufficient to prevent the symptoms of tetany, while in other cases, two of the organs are necessary (Erdheim). The difficulty of formulating any exact deductions in regard to this phase of the subject is further increased by the fact that besides frequent variations in animals of the same species, there is a constant and marked difference in the reaction of different species to partial or complete parathyroidectomy, in respect to the rapidity of the onset and the intensity of the symptoms.

In 1903, Jeandelize, in an exhaustive treatise, reviewed and amplified the whole subject. The following summary from his work is a fair indication of the general attitude at that date.

1. The thyroid and parathyroids are different organs.
2. The results of ablation of the two are not the same.
3. Physiologically, the two organs are dependent upon one another, yet neither can assume the functions of both.

In elaborating the effects of ablation of these organs he calls attention to the fact that thyroidectomy alone does not cause the grave troubles of parathyroidectomy, but instead, especially in young animals, gives rise to troubles of nutrition. The animals remain undersized, their behavior is altered and sluggish, the skin becomes thick and edematous, and the hair becomes coarse. The onset of the change is less than a month after the operation.

On the other hand, he states, parathyroidectomy produces a more rapid onset of symptoms, which are briefly, fibrillary twitchings, tremors, local or general contractions (tonic or clonic), convulsions, dyspnoea, tachycardia, ptyalism, thirst, vomiting, diarrhoea, general weakness and prostration.

He therefore concludes that as a result of insufficiency of the thyroid there occur nutritional disturbances, whereas insufficiency of the parathyroid produces acute convulsive troubles. This, he says, is proved in several species of animals and is probably true for all vertebrates.

In consequence, it was assumed that operative myxedema, which is a nutritional disturbance, is due to removal of the thyroid, and tetany, which is a convulsive trouble, to removal of the parathyroids. Under such an assumption these two con-

ditions necessarily came to be regarded as radically different, a transition from one to the other being out of the question.

Erdheim has recently by clinical and experimental observations further elaborated the evidence of the potentiality of the parathyroids. After partial or total destruction of the parathyroids in rats, with the minimum of injury to the thyroid, he studied the symptom complex of the resulting tetany which occurred in all the cases of total parathyroidectomy. In the animals presenting tetany, by systematic serial microscopic sections of all the organs of the neck, he demonstrated the presence of the thyroid and absence of parathyroid, and thus established the fact that the lesion in every case was purely parathyreopriva.

Although individual differences were marked in his animals, tetany began, as a rule, several hours after operation, and reached its height usually in the first twenty-four hours in the form of epileptiform convulsions. The condition then passed into a chronic state. In the study of the symptom complex due to parathyroidectomy exclusively, besides demonstrating the regular occurrence of a typical tetany, Erdheim also verified the occurrence of regular nutritive changes, notably very excessive growth of the lower incisors. But the association with tetany of some trophic disturbances resembling those observed in cachexia strumipriva was not regarded as a justification for the conclusion that the two conditions are of identical origin.

Erdheim's studies of three cases of human tetany are remarkably significant. In each a partial thyroidectomy was performed for goiter. Unquestionably tetany developed shortly after the operation and death followed on the 131st, 5th, and 17th days. Very complete serial microscopic sections of the neck organs showed in each case the presence of considerable well preserved thyroid tissue, whereas in the first case none of the four usual parathyroids were found, and only two very small accessory parathyroids which lay in the thymus; in the second case only one parathyroid was recognizable, and that was practically entirely necrotic; in the third case not one of the regular four, nor even an accessory organ was found.

A review of all cases of tetany which have been reported as occurring after strumectomy would prove unfruitful. Only a small number are of practical interest in this connection, namely, partial thyroidectomies which permit definite conclusions as to

the involvement of the parathyroids in the extirpation. Pineles¹⁸ compiled thirteen cases of this kind. Of these, there were six cases of extirpation of both lateral lobes, four cases of preservation of the upper portion of one lateral lobe, three cases of extirpation of a lateral lobe with the isthmus. As a result he pointed out that tetany follows partial thyroidectomy most frequently in those cases where extirpation of, or injury to, the parathyroids is most likely to occur; and consequently that tetany is most likely to follow those cases in which only the isthmus or upper part of a lateral lobe is left.

It seems then to have been proven by a long series of careful experiments, strengthened recently by the significant findings of Erdheim and Pineles in man, that tetany following goiter operations is due to the removal of the parathyroid glandules. Nevertheless, this attributes such marked potency to these little organs that, not unnaturally, there are still some observers who are skeptical as to the truth of the assumption, and among them are competent men who have weighed carefully all sides of the question. The explanation of this divergence of opinion lies in the fact that besides such apparently conclusive results as those described above, there have been numerous other investigations, the outcomes of which have not been uniform or positive. For example, even recently, Vincent and Jolly¹⁹ have found that "removal of all four parathyroids was not necessarily fatal," and they "were unable to confirm some other statements which are very commonly accepted" on this subject. Further, Vincent wrote that "the question of the extreme importance of the parathyroids can not yet be considered as settled." Moreover, Caro,²⁰ although familiar with the extensive work of Pineles, has quite recently expressed the opinion that there is no reason for abandoning the former interpretation that tetany is an acute manifestation of the loss of thyroid (not parathyroid) substance. Animal experimentation has failed to convince him of the importance of the parathyroids. He states, moreover, that in goiter cases, the parathyroids are sometimes found to consist simply of atrophic and barely distinguishable lamellæ closely applied to the capsule, and he arrives at the conclusion that in Erdheim's three cases the dependence of the tetany upon the suppression of the parathyroids is by no means proven. However, it is fair to state that almost all observers at the present time regard tetany

following goiter operations as the direct result of the absence of the parathyroid function.

CASES OF TETANY PARATHYREOPRIVA, FOLLOWING PARTIAL THYROIDECTOMY,
COLLECTED BY PINELES,¹⁸ WITH LATER ADDITIONS.

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 v. Eiselsberg, Wien. klin. Woch., 1892, p. 81.
 Beit. z. klin. Chir., Festschrift, 1892, p. 380.
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 ibid., p. 384.
 Wien. klin. Woch., 1906, p. 780.
 Reichel, (2 cases) Münch. med. Woch., 1905, p. 2012.
 Friedheim, Cent. f. Chir., Bd. xxxii, No. 30, Beilager, 1905, p. 30.
 Erdheim, (3 cases) Mitteil. a. d. Grenzgeb. d. Med. u. Chir., Bd. xvi, 1906.
 Monnier, E., Beit. z. klin. Chir., Bd. liv, 1907, p. 63.

ANATOMY OF THE PARATHYROID BODIES IN THE HUMAN
SUBJECT.*

In man parathyroid bodies are constantly present; the number varies. Exact enumeration in an individual case is difficult for two reasons; first, their small size and variable position render it an easy matter to overlook one or more of the bodies; second, various tissues may be mistaken for a parathyroid, especially lymph nodes, hæmolymph nodes, accessory thyroids, thymus rests, and fat. Microscopic examination alone can exclude these tissues.

Berkeley,²¹ as a result of about one hundred and twenty-five autopsies, concluded "that while the number four seems

* For technique of dissection cf. Berkeley²¹ or Petersen.²³

to satisfy the demands of anatomical symmetry, this number is often diminished by one or more " and occasionally increased. He apparently found on an average about two and a half parathyroids per person. Most observers have reported smaller averages, but Verebely²² found four parathyroids 108 times in 138 autopsies. In our own dissections,† the last sixteen resulted in an average of 2.9 per person. In all of these one-half of every suspected tissue was removed and examined microscopically. The other half was left in situ for further reference; a lettered drawing of each specimen facilitated identification of the sections.

The occurrence of the glands in pairs may properly be considered the typical arrangement, a superior and an inferior body being present on each side. Judging from our own dissections and the descriptions of Verebely, Thompson²⁴ and earlier writers, the following seem to be the most frequent situations, and correspond closely to the drawing (Fig. VI).

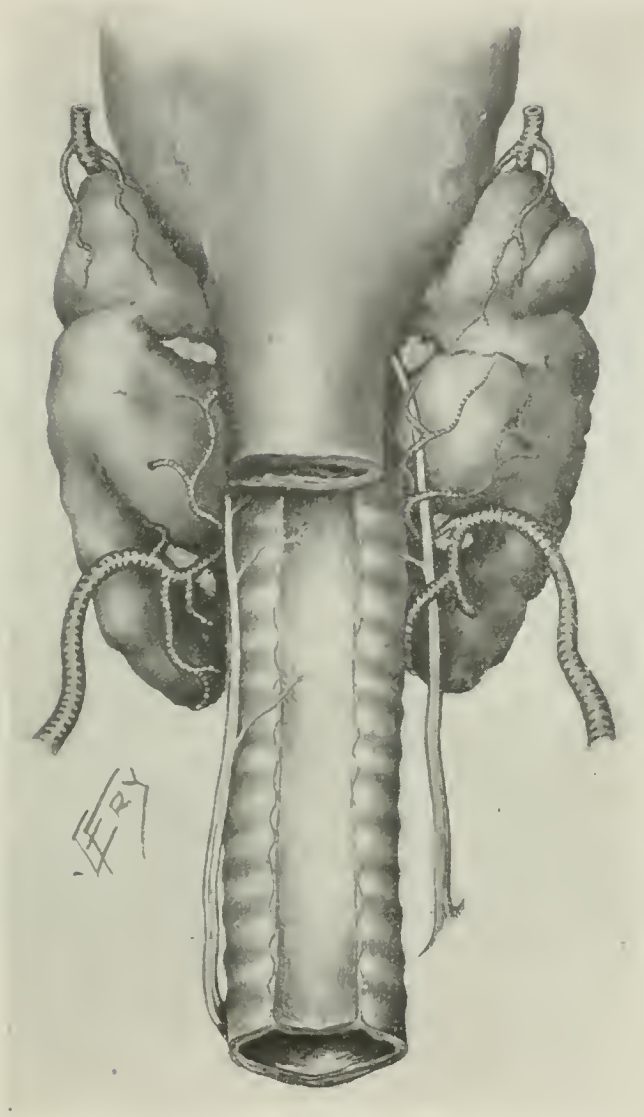
The superior, the more constant in position, lies close to the thyroid in the middle third of its posterior border, approximately on the level of the lower border of the cricoid cartilage (Welsh⁵). It lies in a plane posterior and external to the terminal branches of the inferior thyroid artery and recurrent laryngeal nerve. On the left side the gland is frequently further posterior than on the right.

The inferior, often intimately associated with the thymus (Verebely), lies at or below the inferior pole of the thyroid or on the posterior aspect of the lower third, in which case it is frequently found anterior to the recurrent laryngeal nerve and inferior thyroid artery, close to the thyroid gland at the entrance of the lower twigs of the artery.

Variations from these anatomical positions are frequent. The most striking which we have found was the presence of a large parathyroid on the anterior surface of the isthmus. As common variations in position may be mentioned the tip of the lateral lobe of the thyroid or even above this; anywhere on or

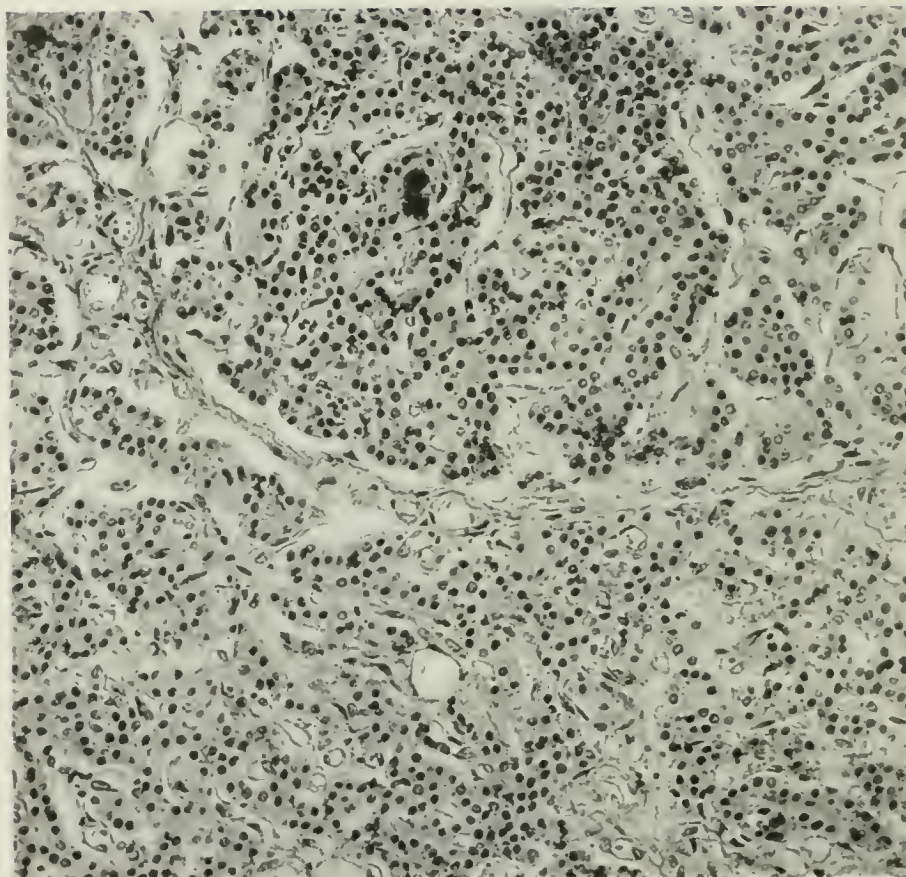
† These were done with the aid of G. C. Whitney, of the Third Year Class of the College of Physicians and Surgeons.

FIG. VI.



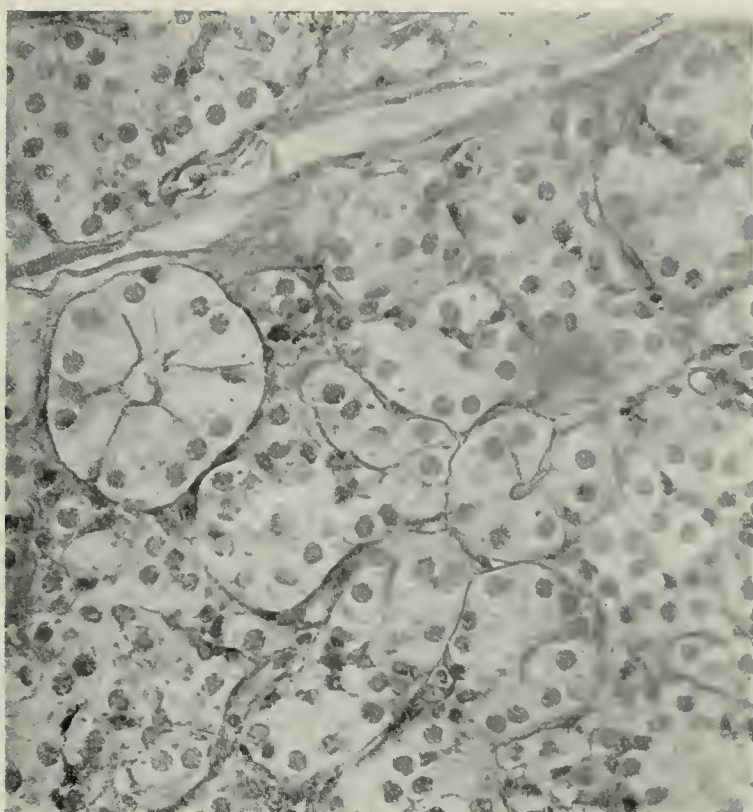
The parathyroid bodies, showing situations in which they are sometimes found.

FIG. VIII.



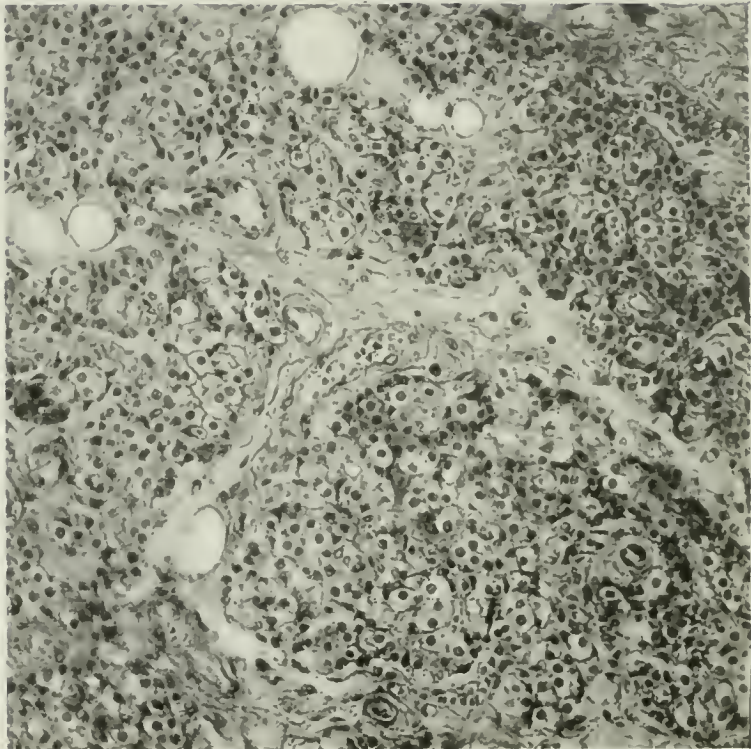
Distribution of cells in strands and groups. Colloid is present in several places. A.

FIG. IX.



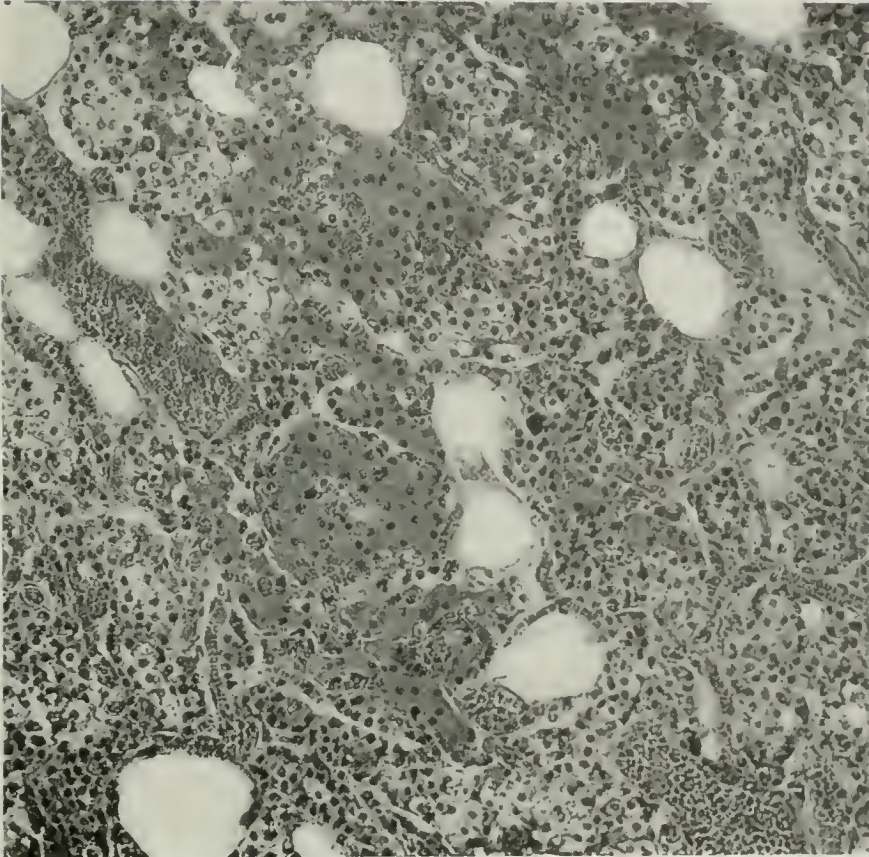
Showing an acinus with lumen.

FIG. X.



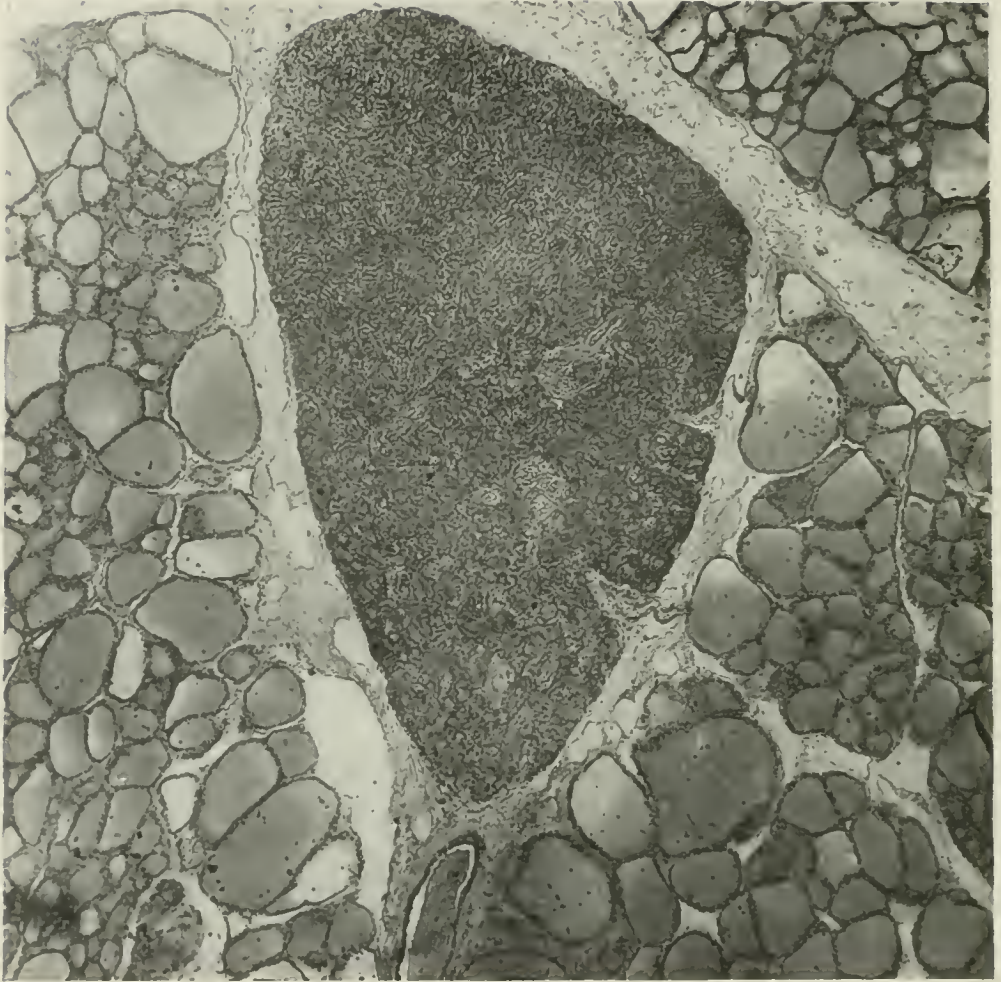
Principal cells.

FIG. XI.



Masses of oxyphile cells.

FIG. XII.



Parathyroid of a dog.

near the posterior border. These sites, however, do not limit the possibilities.

Accessory organs, that is, small accumulations of characteristic parathyroid cells, have been found not infrequently below the thyroid, especially within the thymus.*

While in most cases the glands lie embedded in fat outside of the thyroid, the position of one or more may be beneath its capsule, but only very rarely embedded in its substance (Verebely). Each parathyroid is completely invested with a thin fibrous capsule under which a fine anastomosis can be seen. The size of the organ varies from about 3 mm. to 15 mm., the average being about $6 \times 4 \times 2$ mm. (Berkeley). The bodies are usually somewhat flattened, and may be of various shapes, but especially round, oval, or reniform. Occasionally a parathyroid is subdivided into two distinct parts. The color is a brown red or a reddish yellow. Often a glandule of regular outline presents a relatively large segment of fat. This is said to occur most often in advanced age.

The blood supply of the gland is derived from branches of the superior and inferior thyroid arteries, particularly the former.

Histologically (Figs. VIII–XII) the organ consists of a mass of cells invested with a thin fibrous capsule from which occasional irregular processes reach inward. The gland has a reticular stroma, and is as a rule strikingly vascular, presenting numerous large capillaries. Frequently fat is present, both as an infiltration of the stroma and as a cellular metamorphosis.²⁶ The amount is subject to very wide differences and to this is largely due the variable color of the gland. Especially in advanced life a considerable part of the gland may be replaced by fat. The distribution of the cells varies greatly. They may form an extensive cell mass with only occasional interruptions by vessels and fibrous strands, or they may be broken up by vessels and connective tissue so as to form clusters of lobules or net-like trabeculae. Occasionally there is an alveolar group-

* They have also recently been described as occurring within the thyroid (Getzowa²⁵).

ing of cuboidal or somewhat cylindrical cells with basal nuclei. These at times surround a lumen filled with colloid, which is said by Richardson²⁷ to be retrograde or degenerative material, and not a higher stage of glandular development. Intracellular and intercellular accumulations of colloid also occasionally occur, while glycogen has been demonstrated as a cell inclusion (Petersen).

The cell grouping rarely comprises one alone of the above structural types; as a rule there is a combination of the varieties, the divergencies presented by individual glands in this respect being very wide. The cells themselves are mostly polygonal, sometimes round or cuboidal. They are classified by Welsh⁵ as of two distinct types:

Type I. "Principal cells." These are by far the more numerous. The cell body is relatively small and is either feebly stained with basic aniline dyes, or is clear and colorless. The cells then seemingly consist only of nucleus and membrane which takes a deep eosin stain. We have noted that some of the cells which belong to this group sometimes present an irregular stained peripheral zone and a clear cytoplasm immediately around the nucleus. The variations in the relative width of the clear and the stained zones suggest that under certain conditions the cytoplasm of the clear cells takes on a stain which acts first near the periphery and then progressively toward the nucleus until the whole cell body may be stained.* The nucleus with open chromatin network is large, pale, often ovoid, and frequently, eccentrically situated. The distribution of these cells conforms to the general description already given.

Type II. "Oxyphile cells." These have a relatively large, finely granular body, the granules of which stain deeply with eosin. The nucleus with closely arranged chromatin is small, and round, and takes a deep stain. Compact masses of these cells frequently occur, especially immediately beneath the capsule. They are also distributed as anastomosing columns and as single cells or small groups scattered among the principal cells; lastly, in rare cases, acini with colloid are met with.

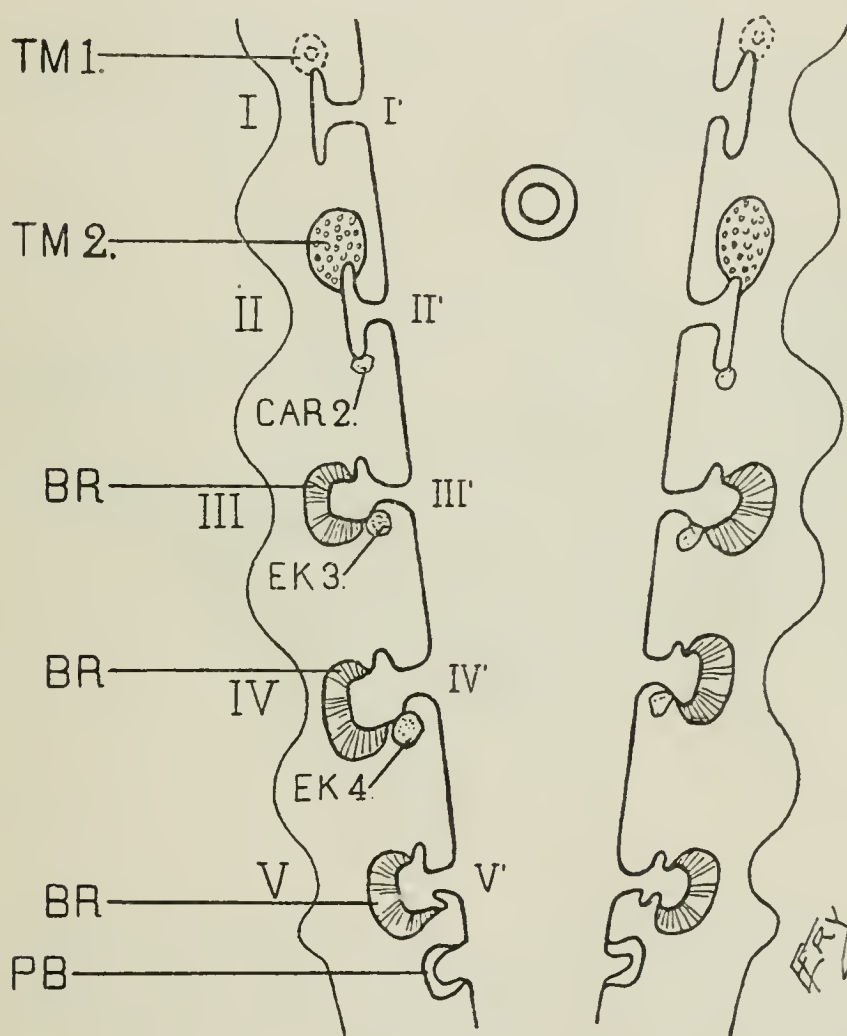
Petersen²³ adds a third type. His Types I and III are respectively the same as Types I and II of Welsh. He describes Type II as not characteristic. The cells are smaller than in I; there is no sharp boundary to the cells, of which the granular protoplasmic body stains deeply with eosin; in places

* Since the above was written, Getzowa has reported similar findings and has gone so far as to subdivide the group into "wasserhelle" or clear, and "rosarote" or pink cells.

the cells are so small that nothing is seen but a complex of deeply stained nuclei. He states that all possible intervening forms occur between Types I and II, and suggests that the organ is a glandular one, and that Type I represents the functioning condition.

In studying parathyroids microscopically, the three varieties of cells can easily be recognized. Further, careful exam-

FIG. XIII.



Diagrammatic scheme of branchial clefts from Anura. (Modified from Maurer.)

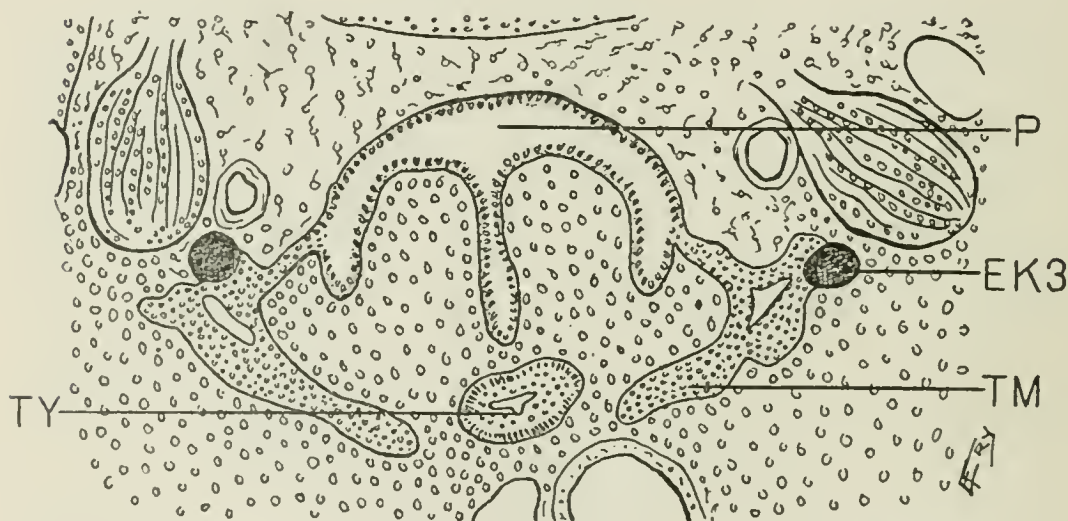
ination enables the observer to trace the cells in some glands from the clear ones of Type I through the above described granular condition to the small granular cells of Type II of Petersen. With more difficulty, gradations also may be traced

from the latter to the large granular cells (Type II, Welsh; Type III, Petersen), where these occur singly or in small groups; but the line of demarcation at the edge of the large groups is sharply drawn. Following the analogy of the salivary and other glands the question naturally suggests itself as to whether the granular cells are not the functioning and the clear cells the resting condition of the cells.†

EMBRYOLOGY.

It is necessary to touch briefly on the embryology of the parathyroids in order to establish their developmental independence of the thyroid.

FIG. XIV.



Transverse section of embryo of echidna, level of third branchial cleft. (Modified from Maurer.)

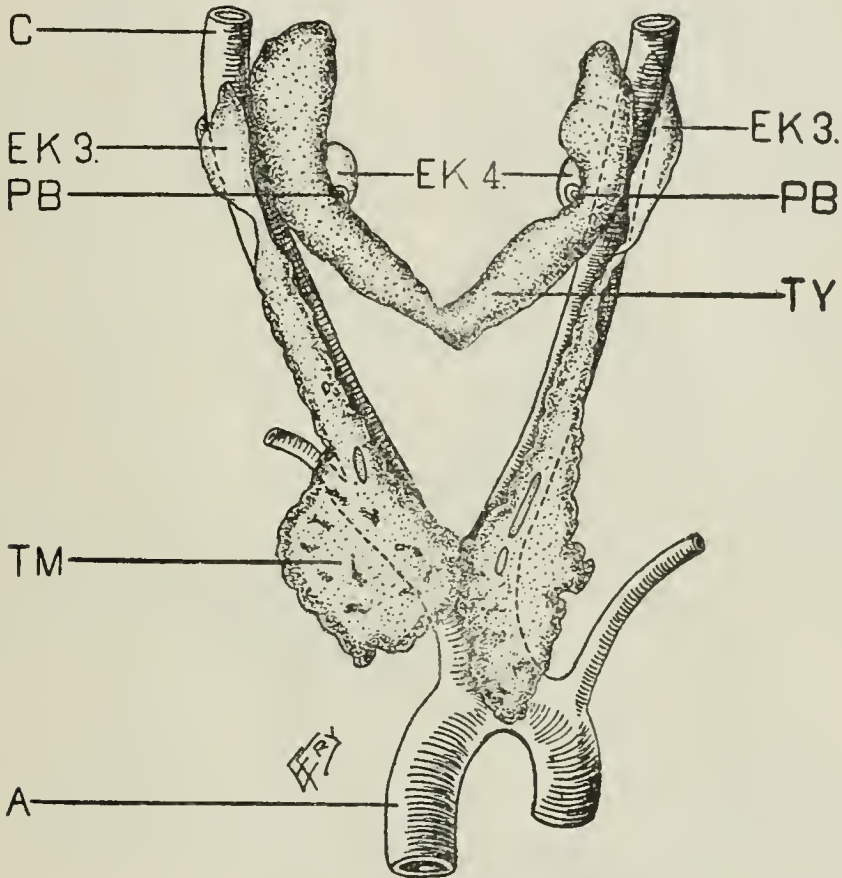
The parathyroids or "epithelial bodies" (Kohn²⁸) are branchial cleft derivatives. In man and most mammals they develop from the third and fourth branchial clefts of each side as masses of compact epithelial cells which are in no way connected with the thyroid (Fig. XIV). Two on each side is the usual arrangement, though anomalies are not infrequent.

The third pharyngeal pouch with its derivatives, the thymus and the parathyroid body, becomes separated from the

† Getzowa²⁹ has recently expressed a similar view.

pharynx. This parathyroid body later comes into relation with the thyroid from the side and forms the inferior parathyroid or outer "epithelial body" (Kohn) (Figs. XV and XVI, EK 3). When the fourth pouch becomes separated, its derivatives, the parathyroid, thymus, and post-branchial body, are primarily connected. The post-branchial body and the superior parathyroid or "inner" epithelial body (Fig. XV and

FIG. XV.



Embryo of rabbit, 16 m.m. long. (Modified from Verdun.)

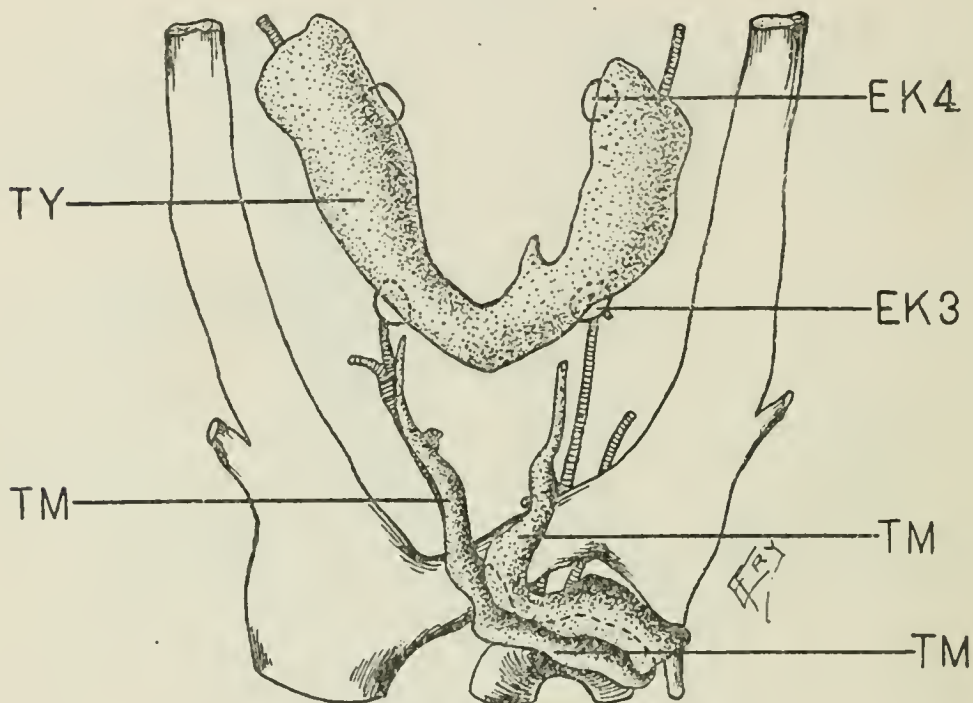
XVI, Ek 4) become annexed to the thyroid only secondarily in the course of development. There is no proof of the assumption that the parathyroids are embryonal thyroid tissue and that they may under certain conditions develop into the mature tissue of that gland. The relation of these bodies to the thyroid must, on the basis of our present knowledge, be regarded as purely topographical.*

* Sophia Getzowa in a very elaborate article has recently advanced

PHYSIOLOGICAL AND PATHOLOGICAL CONSIDERATIONS.

If we accept the view that the parathyroids have a function in part or altogether independent of the thyroid, there are certain hypotheses and experimental results which from a physiological standpoint are suggestive and offer a basis for further investigation.

FIG. XVI.



Human embryo 29 m.m. long. (Modified from Verdun.)

- | | |
|-----------------------------------|--|
| TY. Thyroid. | I-V Branchial clefts, outer aspect. |
| TM. Thymus. | I'-V' Branchial clefts, inner aspects. |
| Car 2 Carotid gland. | P. Pharynx. |
| EK 3 Parathyroid of third cleft. | A. Aorta. |
| EK 4 Parathyroid of fourth cleft. | C. Carotid. |
| PB. Post branchial body. | BR. Branchial rests. |

The hypothesis has been advanced by MacCallum,²⁹ Frommer,³⁰ Lundborg,³¹ and others, that the parathyroids have an antitoxic action, the suppression of which results in the tetany reaction. By this hypothesis tetany parathyreopriva would be

the hypothesis that there may be an independent third parathyroid developed from the fifth branchial cleft. In this way she would explain the occasional occurrence of parathyroid tissue within the thyroid gland in cases in which the extrathyroidal superior parathyroids are also present.

explained as an auto-intoxication. In support of this view is the fact brought out by MacCallum, that the disease in animals is temporarily relieved by bleeding and injection of salt solution into the veins; this, he thought, demonstrated the presence of a circulating toxin. The transmission of tetany to a healthy animal by transfusion of blood from one affected with the disease, although claimed by some as possible, can not be accepted as proved.

If the above hypothesis is accepted, and it seems the most plausible one yet advanced, it may fairly be assumed that whereas the thyroid secretes a substance which is necessary for metabolism, the chief function of the parathyroid is to prevent the action of certain toxic substances regularly present in the circulation.

Attempts to ascribe the etiology of all forms of tetany and even of certain allied diseases, as paralysis agitans, to an imperfect functional activity of the parathyroid glands, have not yet been successful. Nevertheless, Pineles³² assumes the existence of a common etiology for all forms of tetany. He inclines to the belief that further research will trace the unopposed action of the tetanic toxin in all forms of tetany to a depressed functional state of the parathyroids. Chvostek³³ also expresses the view that all varieties of tetany are dependent upon the parathyroid bodies. His observations of tetany, apart from that following goiter operations, led him to believe that the essential feature in the etiology is a functional disturbance of the parathyroid glands so that they are unable to adapt themselves to various changes. It is due to this susceptible condition, he thinks, that menstruation, pregnancy, infectious diseases, etc., are prone to produce the tetany reaction.

The variety of food and the state of fullness or emptiness of the intestinal tract are said to have but little influence on the course of tetany (MacCallum).³⁴ Whether the iodine contained in the organ plays an important role is not known.

In regard to the nervous phenomena of tetany no conclusive explanation has as yet been offered.

Symptoms.—According to v. Frankl Hochwart,³⁵ with

whose descriptions of the disease the following account conforms, tetany parathyreopriva is characterized by certain very striking symptoms which render it practically unmistakable. The most conspicuous of these are intermittent tonic spasms of the voluntary muscles, those of the extremities being most affected. A salient feature is the exclusive involvement of the flexor groups of muscles. Intercurrent contractures of the facial muscles are relatively rare, and the muscles of the chest, back and abdomen participate in exceptional cases only. The tetanic spasms are usually preceded by certain prodromata which persist for a variable period before the onset of the attack. These include headache, sensations of weakness or prostration, more or less rigidity of the limbs, radiating pains and clonic twitchings. The contractions usually begin in the hands, and subsequently involve the feet; less often the feet are affected coincidently or independently. The spasms are almost always symmetrical and bilateral. As a rule, two or more of the fingers are flexed and the thumbs are forcibly adducted, sometimes tightly clasped by the contracting digits. In fifty per cent. of the cases, the wrist also becomes flexed, while flexion of the forearm with adduction of the arm to the trunk occurs infrequently. Exceptionally, the fingers are held wide apart, the terminal phalanges alone being flexed. The feet, when involved, take the position of *pes equinus* or *equinovarus*, as a result of contraction of the muscles of the calf. In the contractions of tetany, the affected muscles become very hard to the touch and oppose a powerful resistance to attempts at passive relaxation. Should this prove successful the tetanic attitude is at once resumed when the traction diminishes. Fibrillary twitchings are sometimes visible in the contracted muscles. The duration of an attack may not exceed a few minutes; or the attack may last for a number of hours; but it rarely persists as long as forty-eight hours. The termination of a tetanic spasm is frequently preceded by symptoms resembling those observed at the onset.

While there may be a free interval of days or weeks between the attacks, unfortunately this is far from being the rule.

There are generally several attacks in the course of the day, whereas the patient's rest at night is unbroken. In the severest cases one attack follows another with alarming rapidity.

Trousseau assumes three distinct degrees of tetany based upon the distribution of the spasms: first, a mild form, affecting the peripheral muscles only; some of these attacks may even be limited to the hands: second, a moderate form, with involvement of the facial, abdominal and trunk muscles: third, a severe form, extending to the involuntary muscles.

Besides the attacks of spasms there are other manifestations of the disease. Certain disturbances of sensation are regularly present, especially pain, which is a constant concomitant of the spasms. Hyperesthesia, paresthesia, or anæsthesia may also be noted. Temporary redness and edema are not infrequently observed over the joints. Trophic and secretory anomalies, such as sweating, loss of hair, and changes in the nails, are not very uncommon.

Of particular significance as bearing on the diagnosis are the tests of Chvostek, Trousseau, and Erb. In two-thirds of all cases of tetany it is possible to demonstrate Trousseau's phenomenon. The symptom consists in the occurrence of a tetanic spasm in a limb as the result of compression of its main vessels and nerve trunks. By the animal experiments of Frankl Hochwart and Kashida, this phenomenon has been shown to depend upon stimulation of the nerves.

Chvostek pointed out the facial phenomenon which can be elicited in tetanic patients by gently tapping over the area of distribution of the facial nerve. The resulting short twitchings are known as Chvostek's symptom, which is especially valuable by reason of the simple technique required for its demonstration.

Erb called attention to the fact that electric hyperexcitability of the motor nerves is regularly present in these cases. There is a marked increase of galvanic irritability, especially in the ulnar nerves; whereas an increased reaction to the faradic current is far less constant. The value of the two tests, dependent upon stretching the nerves of the

brachial plexus and the sciatic nerve, which were so striking in our case, can not be estimated properly until repeated trials have been made in further cases.

The tendon reflexes are normal or increased. A certain number of cases, too numerous to be interpreted as an accidental coincidence, present a combination of tetany with typical epileptic seizures. These symptoms have sometimes been observed after thyroidectomy in individuals previously free from nervous symptoms; and a possible connection between epilepsy and tetany has accordingly been suggested. Certain authors also include among the symptoms of tetany the hysterical attacks which are occasionally present (cf. Frankl Hochwart).

The course of tetany following thyroidectomy has been divided by Frankl Hochwart into three classes: first, cases characterized by onset soon after operation, severe course, and fatal outcome; second, cases in which the symptoms appear soon after the operation but subside after a variable time and are followed by recovery; third, cases in which the patients live and symptoms of myxedema become associated in variable degree with those of tetany.

Diagnosis.—In regard to the diagnosis of tetany, Frankl Hochwart states that it is a simple matter and that there is only one condition, namely, hysteria, which may give rise to symptoms that are strikingly suggestive of those of tetany. But, he says, it will not do on that account to designate tetany or certain of its varieties as a manifestation of hysteria, for there are many features of tetany which can scarcely have anything in common with hysteria. Although he believes imitation of tetany to be uncommon, one can not overlook the possibility of imitation of the symptoms particularly after the tetany has run its course. Such was Minor's³⁶ explanation of a case observed by him.

Tetany, according to Frankl Hochwart, is at once suggested in the case of individuals who have recently undergone an extirpation of the thyroid gland. He emphasizes particularly the importance of Trousseau's sign as a differentiating test. It is unquestionable that responses can be obtained by

pressure in hysteria and other conditions, which may be readily mistaken for Trousseau's sign (Curschmann³⁷). But in a given case, Frankl Hochwart says, the differential diagnosis should be based upon the sudden appearance of spasms as the result of pressure in hysteria, whereas in tetany tonic rigidity is very gradually induced by pressure. He goes so far as to say that in a considerable number of hysterical patients he never succeeded in producing anything akin to Trousseau's phenomenon.

The marked galvanic hyperexcitability of the motor nerves and especially of the ulnar nerves is an important feature for diagnosis. But whether its absence should be regarded as conclusive in ruling out the disease is questionable. Weiss³⁸ reported one case among thirteen cases of tetany examined by him, in which there was no hyperexcitability. Frankl Hochwart says that he observed a similar case but did not regard it as conclusive because it happened that the ulnar nerve was not tested in this particular patient. Recently, he says, a woman came under his observation who he knew had suffered for years from tetany strumipriva, and had generally presented a very marked galvanic hyperexcitability of the nerves. This time it was not distinctly increased and at best could be designated as rather "high."

Treatment.—Much experimental work has been done on this important phase of the subject. There is, however, considerable confliction in the results reported. This is not surprising since the course of the disease in animals is so irregular as to render it extremely difficult to estimate the effect of treatment. Even without treatment, some animals which present profound manifestations of tetany a few hours after operation, pass, after one or more such attacks, into a chronic condition and live for days, in contrast to others in which the first attack proves fatal.

Attention was naturally first directed to the administration by mouth of thyroid and parathyroid glands and their products. Hoffmann,³⁹ Levy-Dorn⁴⁰ and Westphal⁴¹ and many others have reported improvement of the symptoms of

tetany in man after feeding thyroid gland or its derivatives. Most observers, however, disclaim any favorable results with exclusive thyroid therapy, and Loewenthal and Wiebrecht ⁴² ascribed the apparent effects of thyroid feeding to the admixture of parathyroids. Yet it does not appear to have been proven that either mixed thyroid and parathyroid or even pure parathyroid feeding can control the disease in animals. According to Biedl ¹⁶ (p. 321) "the sequellæ of parathyroidectomy cannot be prevented by parathyroid feeding." MacCallum ³⁴ reported benefit as the result of intravenous injections in parathyroidectomized dogs of very large amounts of prepared parathyroids of dogs. Administered to animals in subcutaneous injections, thyroid gland derivatives have proved inefficient, whereas parathyroid products are said to have met with some success at the hands of Beebe, ⁴³ and others. With the nucleo-proteid Beebe claims that amelioration or disappearance of the symptoms is almost constant.

Uncertainty prevails as to the effect of transplantation. Transplanted parathyroid tissue survived in the animal experiments of Cristiana, ⁴⁴ and became atrophied after a variable time in the experience of Camus, ⁴⁵ whereas Lusena ⁴⁶ refers to cases in which the subcutaneous transplantation of parathyroid seemed to have a decidedly favorable effect.

Of the applicability of the above methods in man little has been demonstrated. Here the effects of treatment are difficult to estimate because of the impressionable character of the patients and the frequent modification of the disease by hysterical manifestations. Some successes with thyroid feeding have been reported, as stated above, and MacCallum, ⁴⁷ Marinesco, ⁴⁸ Loewenthal and Wiebrecht ⁴² and others have reported improvement following the administration of parathyroid material by mouth. Yet the results in animals apparently have demonstrated that in the treatment of tetany by parathyroid therapy, subcutaneous administration is the means which offers the best prospect of controlling the disease. Beebe's nucleo-proteid at present appears to be the most efficient product for this purpose.

There is no record before the present of attempts to establish a permanent cure in man by parathyroid transplantation.

Transplantation.—The important part which tissue transplantation now occupies in the experimental work which is being done in tetany, and its peculiar significance as a possible therapeutic agent in this disease warrants a brief review of the main principles of the subject.

Parenchymatous organs, in part or in entirety, seem to have been successfully transplanted in a number of cases between animals of the same species, and even between human beings. But the transplantation of such tissue from an animal to man or experimentally between animals of different species, has almost * uniformly failed, presumably by reason of some cytolytic property of the fluids of an animal towards tissues of another species. The implanted tissues certainly do not abide permanently, and temporary functional effects may fairly be assumed to result from absorption of the implanted tissue and its juices.

The behavior of individual glandular organs when transplanted is extremely variable. According to Payr,⁵⁰ those organs which have an internal secretion seem to be far better adapted to transplantation than those with an external secretion.

Of parenchymatous transplantation, that of the thyroid gland is by far the most important. The original experimental transplantations of this organ in animals were done by Schiff,⁵¹ and the first attempt in man was made by Kocher in a case of cachexia strumipriva (1883). The functional results in both instances were transient only. It was tried by Bircher⁵² and others for myxedema, but with similar results.

The first attempts which seem to have been successful in respect to the life and function of the transplanted thyroid tissue were those of v. Eiselsberg⁵³ and Cristiani.⁵⁴ But whether this functional activity is only temporary, as urged by Ender-

* Cristiani⁴⁹ reported some success in the transplantation of thyroid tissue from one animal to another of a different kind.

len,⁵⁵ is still problematic. However, Payr⁵⁰ has recently reported striking and suggestive results in animals and in the human subject. He transplanted thyroid tissue from the mother into the spleen of a six year old child who was suffering from congenital myxedema. Marked improvement is said to have resulted, and to have persisted up to the time of publication eight and a half months after the operation.

Among other tissues of which successful transplantations in animals have been reported are the ovary, mammary gland, adrenal body, and kidney; in the human subject, besides the thyroid, the ovary may be mentioned.

Among Carrell's remarkable successes in transplantations of the kidney are some in which he demonstrated that the viability of the organ was preserved during an interval of two hours between its excision and its implantation. When an interval thus elapses it has been shown by Cristiani that the viability is best retained by preserving the tissue in serum from the same species of animal or in inactivated serum of an animal of another species; the ordinary salt solution proves toxic. Flexner found that this also applies in the case of pathological tissue.

As to the most favorable site for implantation, opinions differ. The main places to be considered are the subcutaneous tissue, extraperitoneal tissue, peritoneal cavity, omentum, and spleen. In determining the situation for election in a given case attention must be given to the freedom from serious danger which it offers and to its qualifications for supporting the life of the implanted tissue.

Looking now towards the possibility of parathyroid implantations, from general experience grafting between animals of different species would not appear promising; but for obvious reasons the question should be definitely settled on account of therapeutic possibilities. Between animals of the same species, on the other hand, some prospect of success seems offered. Payr mentions several cases in his experiments in which living parathyroid as well as thyroid tissue was found embedded in the spleen at a considerable interval after the

transplantation. Moreover, since his thyroid implantations were said to be functionally successful, by analogy one might reasonably look for similar results with the parathyroid. Finally, Lusena and Cristiani seem to have obtained some functional effects in pure parathyroid transplantations.

With the view of solving the therapeutic possibilities of parathyroid transplantation in man, experiments were undertaken to establish the following essential questions:

1. Can the parathyroid live if transplanted, first, between animals of different species, second, between animals of the same species?

2. If it lives, does it functionate; and, if so, is the function permanent?

In the first series, the rabbit was adopted as the donor, because of the accessibility and definiteness of the external parathyroids which were regularly employed. The dog was adopted as the recipient in both series because it seemed likely that the subsequent removal of the normal parathyroids would be relatively simple and certain. Experience showed that this choice was a mistake and that some other animal probably would have proved better.

The spleen was taken as the site for implantation because of Payr's successes and his claims in favor of it. He suggests that the spleen offers the most suitable combination of the two main factors necessary in tissue receiving an implantation, namely, high vascularity and richness in lymphatics.

The points of interest in my experiments were as follows: In one rabbit one external parathyroid was removed; the other was exposed and its size recorded; no tetany resulted. Eighteen days later the second external parathyroid had increased considerably in size. Similar enlargement has been noticed by others, and it has been suggested that it is in the nature of a compensation for the organ lost. In seven rabbits both external parathyroids were removed; there followed no tetany except in one animal which presented twitching of the head for about two days. In three rabbits complete thyro-parathyroidectomy was performed; in two, tetany developed with death in

thirty and forty hours; the third died on the ninth day, but no positive signs of tetany were noticed. In four dogs complete thyro-parathyroidectomy was performed. In all, tetany of variable intensity developed with death in two to sixteen days. In four dogs complete parathyroidectomy was done, leaving the thyroid. In three fatal tetany developed; in one, questionable tetany without death.

These results simply bear out the experience of many others in regard to the effect of removing the parathyroids. The tetany developed in the dogs in spite of the fact that in all except three of the cases implantations had been made.

Parathyroids were implanted into the spleen of twelve dogs, that is, the eight mentioned above and four others. In eight of these, sixteen rabbit parathyroid were used; in four, ten dog parathyroids. The technique of Payr was followed with some modifications. The implantations were made from eight to twenty-eight days prior to one of the above operations for removing the normal parathyroids, except in one case where the implantation and parathyroidectomy were done simultaneously.

CONCLUSIONS.

From the preceding considerations it is evident that the removal of all and possibly even of a part of the parathyroid bodies results in tetany, that the symptoms of this disease are striking, that the diagnosis is usually simple, and, finally, that efforts directed towards its cure have not as yet been proved to be successful.

In the case reported at the beginning of this paper, the diagnosis of tetany was based, in the absence of thorough electrical tests, first, upon the fact that the patient had never presented any hysterical or other nervous manifestations previous to the onset of the typical clinical features of tetany four days after an operation for goiter which thus supplied a direct anatomical basis for the disease: second, on the analysis of the symptoms, the most suggestive features being the frequent attacks of symmetrical and bilateral tonic contractures of hands and feet, the involvement of the flexor muscles exclusively, the

presence of Chvostek's and Trousseau's signs, the latter characterized by slow contractions accompanied and preceded by cramp-like pains, the additional demonstration of the mechanical excitability of the motor nerves by the stretching of the sciatic nerve and nerves of the brachial plexus; and, finally, the fact that coincidentally with the typical spasms all of the above tests disappeared.

Assuming then that this was a case of true tetany, the explanation must be that at her former operation in Bern two parathyroids were removed with the left lobe of the thyroid. Since no symptoms occurred until after my operation this was undoubtedly the cause, presumably through the sacrifice of sufficient parathyroid tissue to upset the functional equilibrium, which must have been at that time very unstable as the result of the previous operation. It is not possible that both the remaining parathyroids were sacrificed, for in that case a fatal tetany would undoubtedly have resulted. Since no parathyroid could be found in the tissue removed, it is probable either that the lower and inferior one of the right side was crushed in the clamp which was placed across tissue in which this body sometimes lies, or that the blood supply of one or both of the parathyroids on this side was interfered with by the ligation of the inferior thyroid artery. The latter explanation was suggested to me recently by Dr. W. G. MacCallum.

In this case, although improvement and apparent cure resulted during the administration of Beebe's nucleo-proteid and after the subcutaneous implantation of human parathyroids, the fact can not be lost sight of that the improvement may have been due to a compensatory hypertrophy of the upper right parathyroid body which is supposed to have been left. Although it seems probable, on the basis of this case and the investigations of others, that by appropriate organotherapy the symptoms of tetany can be controlled at least temporarily during the administration, the question has not been definitely settled. Moreover, the effect of transplantation is still problematic. From animal to man it offers no prospect of success; and we are forced to admit that it is uncertain whether para-

thyroids transplanted between animals of the same species, even under the most favorable conditions, can functionate, even if they do survive. It is consequently equally questionable whether they can grow and functionate when transplanted from man to man. Although subcutaneous implantations seem warranted on account of their freedom from danger and the possibility that they were effective in the case under discussion, the obvious technical difficulties and dangers of implantation into such a place as the spleen, are so great as to forbid the attempt until success in animals has been thoroughly demonstrated.

Considering then the uncertain status of all proposed methods of treatment, the importance of prophylaxis is self-evident. In this connection it is significant that the frequency of the disease has markedly diminished since the adoption as routine practice of leaving part of the thyroid in goiter operations.

The practical side of this subject has been furthered by recent researches only in so far as it has been demonstrated that not merely sufficient thyroid must be left in order to prevent the occurrence of myxedema, but also that a definite part of the thyroid must be retained in order to ensure sufficient parathyroid tissue and thus guard against tetany. The truth of this statement is demonstrated by the case presented in this paper and by the cases of tetany following partial parathyroidectomy collected by Pineles and quoted above with later additions.

The operator must attempt to leave at least two of these bodies in situ, with blood supply unimpaired. When we consider how difficult it is to locate the parathyroids at autopsy on account of their small size and variable situation, it is evident that under the conditions which prevail in an operation, their recognition could not be depended upon and would prove a matter of chance. Therefore, in order to preserve the parathyroids, it is necessary to leave the posterior part of at least one lobe of the thyroid, in connection with which two of these bodies usually lie. Whether this is done by leaving one lobe

completely or in part, is a matter for individual choice in a given case; but in pursuing either course the thyroid vessels, especially the inferior, on this side should not be ligated. The practice of leaving the isthmus only is obviously a very dangerous procedure. In addition, to ensure still further immunity from tetany, even when one entire lobe or the posterior part of a lobe is left, certain precautions should be taken if the whole of the other lobe is removed. In the removal of this lobe the dissection of the thyroid gland should be carried as close as possible to the true capsule of the organ, and independent, small bits of tissue should be sought for in this situation, stripped from the thyroid, and left uninjured. Moreover, in ligating the inferior thyroid artery on this side care should be taken to avoid including in a ligature or clamp the inferior parathyroid which frequently lies in close relation to this vessel.

From the preceding review and discussion it is evident that numerous questions relating to the parathyroid bodies and tetany are still unsolved. Two important points, however, may be accepted as proved by the overwhelming evidence of experimental and clinical observations: first, that tetany following goiter operations is due to operative interference with the parathyroid bodies; and, second, the corollary of this, that in operative procedures parathyroids and their blood supply must be maintained inviolate.

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OBSERVATIONS UPON A FORM OF EXOPHTHALMIC GOITRE OCCURRING IN A DOG.

BY CARL EGGERS, M.D.,

AND

J. W. DRAPER MAURY, M.D.,

OF NEW YORK.

THE history of this case was briefly as follows:

The mother was an imported Irish terrier brought over on a cattle ship. She was badly treated during the trip and also for some time after her arrival in this country. At length she was picked up by a stable hand, who kept her in a rather cold, dark and damp stable. Her neck had always been noticeably full, but not remarkably so. Under the stableman's care, she revived and became bright and active. About eight months later, she gave birth to a litter of pups. These were sired by a thoroughbred Irish terrier. He also had been kept under poor hygienic conditions in the cellar of a saloon.

There were five pups. One, a female, was drowned at birth. Another died early from some unknown cause. About three weeks later, the remaining pups were all observed to have a swelling in the neck and they seemed to be weak in their hind quarters. Unfortunately no particular attention was paid to them until one died with symptoms that were noticeably like those of exophthalmic goitre. The two remaining pups were then seen by a member of the Surgical Research Laboratory staff. He noted that the thyroid gland was markedly enlarged; that the hind quarters of the dog were very weak; that the pulse was exceedingly rapid and that there was a very marked movement of the thoracic wall and indeed of the whole body due to the violent heart action. A very fine muscular tremor was quite marked.

One of the two remaining pups died before operation was decided upon, and the body unfortunately was destroyed before an autopsy could be performed. The last pup was then taken to the Laboratory and there presented the following symptoms:

A very marked swelling of the thyroid gland which was more prominent on the left side. It was elastic and throbbed synchronously with the pulse. The pup was extremely weak in the back and hind legs. When the photograph in the accompanying cut was taken, the animal was unable to stand and had to be supported as shown. There was very marked tremor. Little or no exophthalmos was present. The pulse had exaggerated force. It ran between 160 and 170 and was of high tension.

Upon the history, the presence of the tumor, the tremor, and the

tachycardia, a tentative diagnosis of exophthalmic goitre was made and operation decided upon.

The dog was given a dose of morphine hypodermically and when under its influence was anæsthetized with ether. The thyroid gland was exposed through a median incision. It was found to be enormously enlarged and to have an abnormally large vascular supply. The left lobe was larger than the right. The isthmus was ligated in two places and was carefully divided between ligatures. The gland was found to be well encapsulated and it shelled out easily. The parathyroids were not seen. The wound was washed out and closed with a continuous silk suture and dressed with a formalin pad. The pup re-acted well after the operation.

The next day an immediate improvement was noticeable in the animal's condition. The pulse rate had fallen to 120 and the impulse of the heart-beat against the chest wall had diminished very appreciably. Prior to operation it had been possible to count the heart beats by simply looking at the animal's body. After operation, this could no longer be done.

Four days after operation, the pulse had reached 90. There was no longer any impulse transmitted to the hand. The animal's general condition improved rapidly. He gained weight and all tremor disappeared. Weakness, however, persisted for some time, but at the end of two weeks, he was in a reasonably normal condition. The animal lived for six weeks after operation and died without giving any manifestation of a recurrence of the symptoms described.

Dr. MacCallum, of Baltimore, in speaking of this case, said:

"I should think it difficult to make a definite diagnosis of exophthalmic goitre in a dog, but I think the histological character of the goitre would furnish the best evidence of the nature of the condition. The literature is very meagre and I think any such case ought to be reported." Dr. F. C. Wood, of the Path. Dept., stated that this gland, a section of which is here shown, presented the usual morphology of exophthalmic goitre. His language is as follows:

"The microscopical examination of the thyroid tumor which you sent me some time ago, shows a growth of the type which we are accustomed to see in exophthalmic goitre in man."

Woods Hutchinson says: "I can quite readily imagine such a condition of affairs developing in the dog, as ordinary cystic and fibrous goitres are quite common in the species and generally give rise to few or no symptoms except those connected with their size. Similar conditions are also fairly common in horses and sometimes give rise to some difficulty, through pressure upon the trachea, and pneumogastric. I have also reported briefly a number of cases of cretinism occurring in puppies in goitrous regions, particularly in the Yakima and Puyalap valleys in Washington."

Wesley Mills, the well-known authority on dogs, writes from McGill University in reference to this case: "I have worked upon the effects of removal of the thyroids and parathyroids in dogs and I have seen a good many cases of ordinary chronic enlargement of the thyroid, but such an

FIG. 1.



Goitre in the neck of a dog.

FIG. 2.



Exophthalmic goitre in dog.

acute case as you have had the opportunity to study has not come to my notice. In all my study of the dog, I have been impressed by his resemblance to man, both physically and psychologically. The chronic enlargement of the thyroid always gave way in my experience to the treatment usually employed for human beings. I see no reason to doubt that your case was one of exophthalmic goitre."

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EXPERIMENTAL STUDIES UPON THE THORACIC ŒSOPHAGUS—A PRELIMINARY REPORT.

BY NATHAN W. GREEN, M.D.,

AND

J. W. DRAPER MAURY, M.D.,

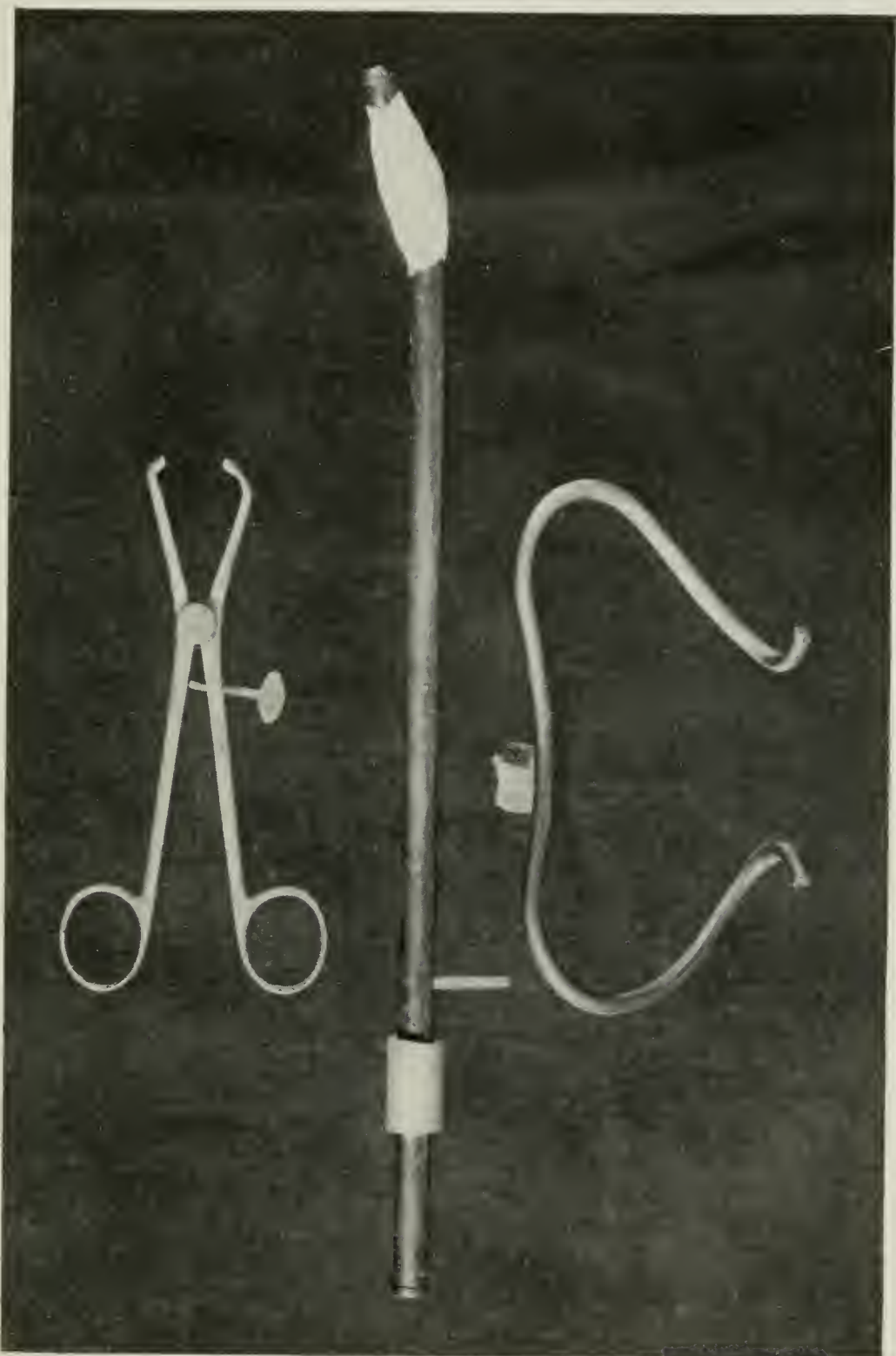
OF NEW YORK.

THE purpose of the experiments outlined in this report is to determine what can be done transpleurally in the treatment of œsophageal stenosis while using the more simple positive pressure method of overcoming the embarrassment necessarily due to collapse of the lung during open chest work.

A few words may first be said concerning the apparatus used, the construction and the method of introduction of the intra-laryngeal tube. The air pump and valve is that designed by Mr. J. T. Hoyt of the physiological department and is of the type mentioned in a former paper.¹ The means of conveying the ether vapor is also the same as used in the experiments detailed in that paper. The canula, however, is much simpler and consists of a plain 8 mm. brass tube 12 in. long slightly curved and rounded at the laryngeal end and supplied with an obturator which tightly fits the rima glottidis. This consists merely of a few turns of surgeons' plaster so wound around the tube as to make a fusiform enlargement of about 12 mm. at its maximum diameter (see photo., Fig. 1). In the side of the tube near the aboral end is bored a small hole of about 2 mm. diameter. This serves as vent for the expired air. Around the tube is a small collar, a piece of tubing, which may be slipped over this aperture when it is necessary to inflate the lungs thoroughly before closing the chest wound. The aperture is sufficient for all expiratory purposes. No partial

¹The Positive Pressure Method of Artificial Respiration with a Practical Device for its Application in Thoracic Surgery.—Surgery, Gynecology and Obstetrics, May, '06.

FIG. 1.



Instruments to facilitate intra-thoracic work. A match has been inserted in the vent hole referred to in text.

vacuum is used as it was demonstrated to be unnecessary. The intubation tube is held firmly in place by a light clamp made by incurving the blades of an Otis meatal dilator. This clamp is applied oral to the hyoid bone and is so adjusted as not even to bruise the skin under the floor of the mouth. Yet this simple appliance serves to hold the intubation tube firmly in place, and it was noticed repeatedly that neither the pressure from this clamp nor that exerted by the tube itself upon the vocal cords was sufficient to cause the least sign of paralysis. This was shown by the ability of the animal to bark immediately after recovery from anæsthesia.

The introduction of the tube is a very simple matter if attention be given to the following details. In the first place, the primary anæsthetization must be profound. The dog should then be placed squarely on its back with head extended. An attendant slips a towel over the canines of the upper and another over those of the lower jaw holding the mouth very widely open. The operator then holds the tongue in a third towel and draws it forward until the epiglottis is seen. If strong sunlight be thrown from above on the exterior of the neck, the proceeding is much facilitated, for it gives a very striking illumination through the tissues and enables the operator to place the tip of the intubation canula directly in the open rima.

Having completed the intubation and having secured the tube with the clamp, the dog is placed on its right side, a small cushion being tucked underneath the body opposite the site of the operation.

The 6th intercostal space is then located by counting from below up. The skin and superficial muscular incision is made over this space. The tissues are then drawn downward and the pleural cavity opened by sectioning the intercostal muscle midway between the ribs in the 7th space. This gives on closure of the wound an air tight flap—a condition very necessary in the dog, as leakage of air into one pleural space causes collapse of the opposite lung owing to the mobility of the soft parts forming the mediastinum.

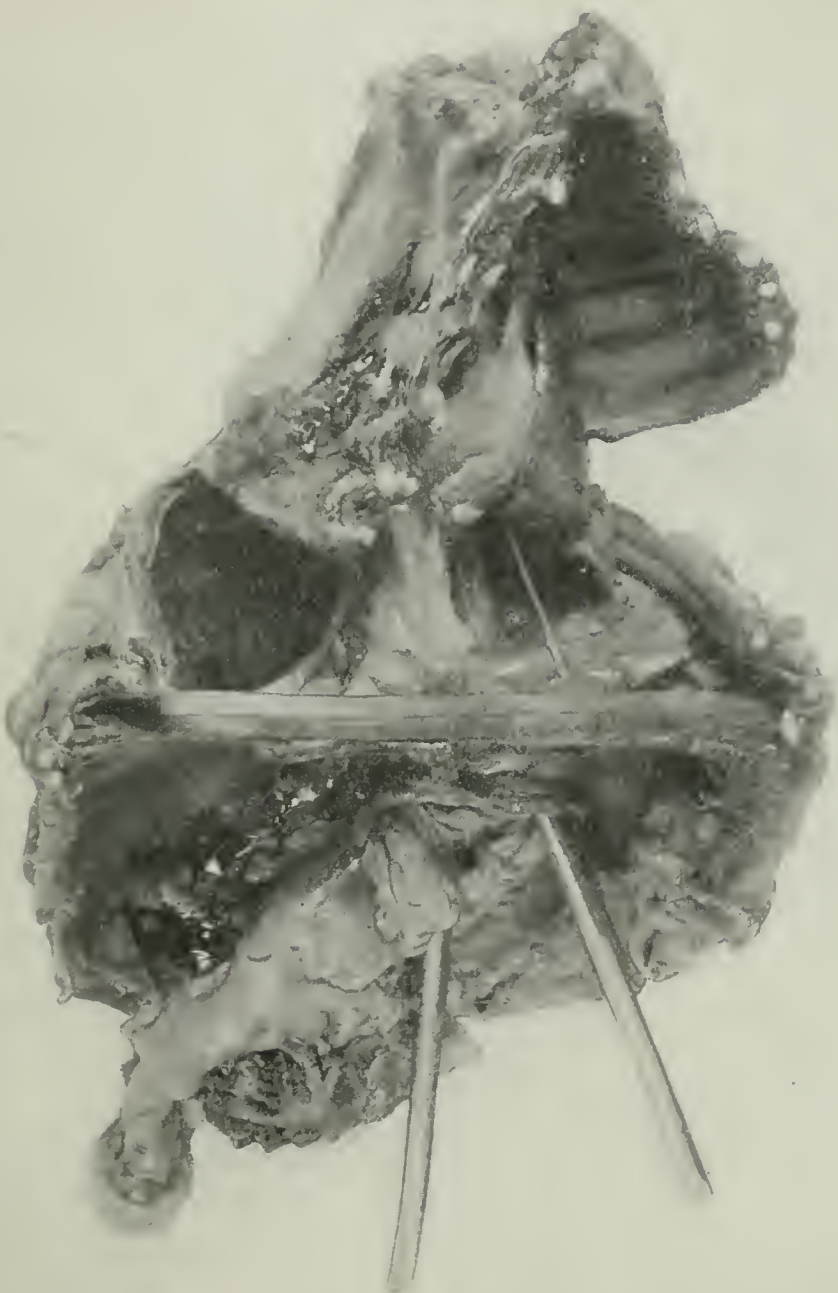
Before the pleuritic layer is opened the condition of the lung should be studied by direct inspection and the amount of expansion regulated. This can easily be done as the pleura is quite transparent. Regulation of the expansion may be effected by gauging the volume of air delivered and by changing the size of the expiratory vent by the rubber collar already referred to.

Having opened the pleura, the ribs are then drawn apart and a self-retaining retractor inserted. This retractor, as shown in the photograph (Fig II), consists of a bent brass rod, it having been found more serviceable than the larger instrument designed for human use. The lung is then held out of the way by delicate retraction. This allows an immediate and unobstructed view of the œsophagus, for the ribs at the point of entry separate quite freely.² The vagi are usually found as two large trunks with a diagonally communicating branch. From this point on the manipulations must be of the most delicate nature possible. The vagi are carefully separated from the œsophagus by sharp dissection for a distance of 5 cm. Unavoidably much of the serous covering of the œsophagus is removed at this time, but it should be preserved so far as possible. At a point about 1 cm. oral to the point of investiture of the œsophagus by the diaphragm, a cuff of serosa is separated by circular incision around the œsophagus and this cuff is stripped down until the stomach appears in the wound.

The beginning decussation of the vagi on the stomach and the vessels, with the frequent exception of one branch which must be tied—are pushed back on the stomach. At this point the peritoneum appears on the left side and must be opened about half way around the œsophageal end of the stomach. After carefully protecting the cavities by pads a portion of the gastro-œsophageal juncture 2 cm. or more in length is removed. Clamps should not be employed as their use may be followed by a late perforation at the point maximum of pressure. Two retraction Lembert sutures are placed

² See abstract Sauerbruch's recent technic Kocher: *Chirurg. Op.* V aufl. p. 737 *et seq.*

FIG. II.



Photograph of entire chest. Ribs spread apart by piece of wood. Stomach split near greater curvature and sounds introduced through the separate openings into esophagus. A sequestration operation.

FIG. III.



Figure showing appearance of tissues and relations of parts after intra abdominal sequestration of gastro-oesophageal union. P, pylorus; L, line of union (between pins) where normal opening of oesophagus was closed; N, new line of union of oesophagus to stomach; D, diaphragm which is seen to be oral to N; O, oesophagus; P, Pylorus, V, vagi.

in the oral part of the œsophagus which is then drawn up into the thoracic wound; the opening plugged with gauze and the stump covered with a pad. The wound caused by the resection of the gastric wall is then closed by a three-layer suture and the stomach is dropped back into the abdominal cavity. An adjacent portion of the cardiac end of the stomach is then grasped in the fingers and drawn up into the chest. Two retraction Lembert sutures are placed in the stomach and this organ incised between them. An end-to-side implantation of the œsophagus into the stomach is then made according to the usual method, three layers of silk sutures being used. The stomach is then dropped back into place again and the diaphragm sutured to the œsophagus oral to the point of union with the stomach, so making the gastro-œsophageal suture line intraperitoneal and within reach of the omentum (Fig. III). The chest cavity is then freed from any blood clots remaining, the positive pressure is slightly increased and the chest wound sutured in layers, leaving a small opening for the escape of air while the lungs are fully distended. This is finally closed and the operation is completed.

The conclusions from these incomplete studies are as follows:

Intubation practised with the simple instruments described is thoroughly practical and for all surgical research work should supersede tracheotomy.

Positive pressure if supplied with a proper cut-off valve is a simple and efficient means for producing artificial respiration in surgical work. We have had no death directly attributable to it.

The flap formation in the chest wound is an important point in the technic.

The protection of the pleural cavity from infection must be rigidly enforced and when the point of resection is near the cardia this may be conveniently accomplished by the sequestration of the gastro-œsophageal wound into the abdominal cavity. The omentum will then apply itself to the wound area as in any intestinal operation.

Efforts to carry a portion of the omentum into the chest in order to profit by its protecting influence in case the wound area was too oral to allow of intra-peritoneal sequestration were sometimes successful, but it is difficult to maintain the omental blood supply by the method we employed.

In connection with these experiments we wish to report that we have tried gastro-œsophagostomy by means of the Murphy button—by means of end-to-end suture bringing the stomach up through a new opening in the diaphragm—by a lateral anastomosis, by one and also by two stages—and by the twine triangular stitch.³ This last method we found very satisfactory in side-tracking the natural cardiac orifice. The photograph (Fig. IV) shows a view of a specimen so obtained. Our experience to date leads us to the belief that this or a two stage operation will prove to be the one of election, for the simple one stage intra-thoracic œsophageal section has a very high per cent. of septic mortality (in dogs).

We have also attempted Roux's method⁴ of œsophago-jejunosomy. His technic was followed in all respects save that the gut segment was carried up through the chest instead of subcutaneously. Kocher,⁵ after describing the method outlined by Roux, states that he essayed it on a man but was obliged to proceed to simple jejunostomy because of the failure of circulation in the isolated jejunal segment. Our results appear to justify the conclusion that in dogs at least the isolation of a portion of the jejunum by Roux's method is impracticable because of circulatory failure.

³ Twine in lieu of the elastic ligature for performing gastroenterostomy, Jour. A. M. A., Sept. 17, '04.

⁴ Semaine Médicale, Jan., '07.

⁵ Chirurgische Operations lehre, p. 907.

FIG. IV.



Photograph of specimen obtained by using the twine triangular stitch for gastro-oesophagostomy. S, S' are sounds which enter oesophagus orally; S' passes through the triangular stitch opening; S, through natural opening and on into pylorus P; L is a finger of lead pointing to T, the triangular stitch which is just hanging to the margin of the stoma.

STUDIES UPON THE FUNCTION OF THE PYLORUS
AND STOMA AFTER GASTROENTEROSTOMY
HAS BEEN PERFORMED.

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AND

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A GREAT deal of speculation has been indulged in as to the physiological conditions which exist after the operation of gastroenterostomy. Undoubtedly the most important and thoroughly scientific and accurate observations were made by Cannon in his recent studies at the Harvard Medical School. Together with Murphy, he performed the operation of gastroenterostomy on a large number of cats, and after full post operative recovery, studied the animals' intestinal mechanism through the agency of the fluoroscope. He found according to these observations that all food was driven by the muscular contractions of the stomach through the pylorus, the stoma playing no practical part in alimentation. This was a profoundly important contribution.

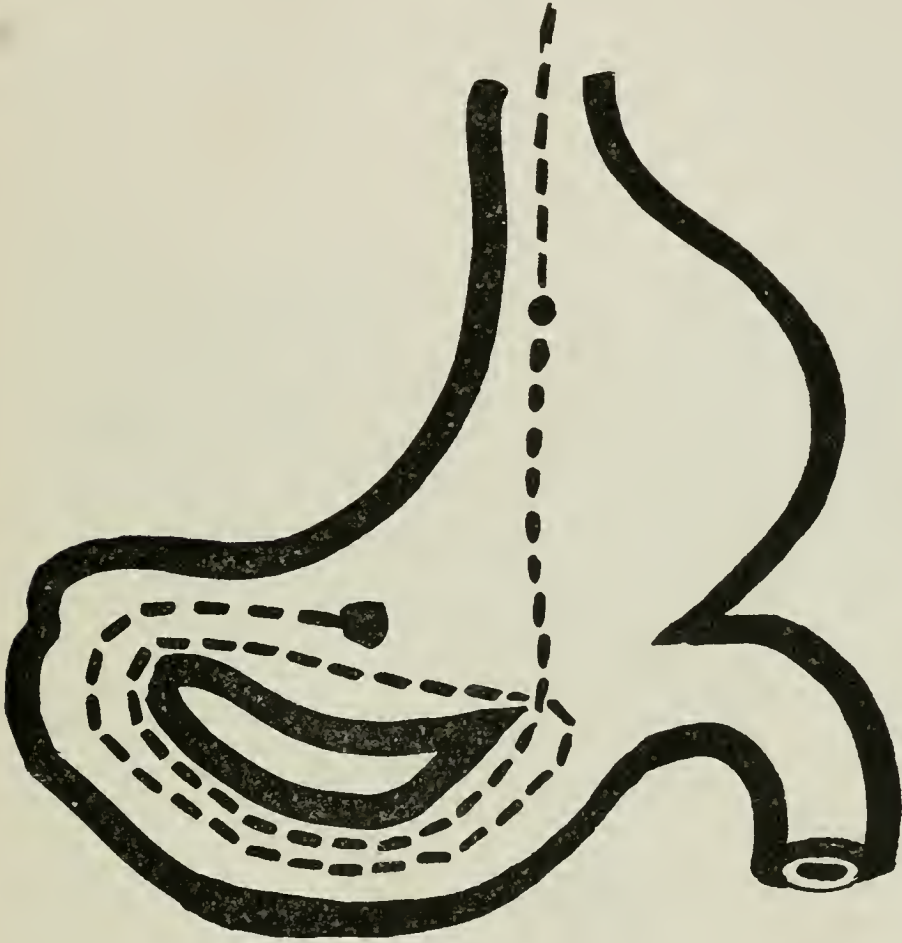
About a year ago, the class in operative surgery at the Surgical Research Laboratory at Columbia University performed the operation of gastroenterostomy. We were making some observations upon the efficacy of various forms of superficial dressings, and in this particular case, a certain dressing was applied upon a small piece of gauze. While not under observation, the animal picked out the smaller dressing from under the external bandage and swallowed it. Some time after this, he was chloroformed for the purposes of study, and upon opening his stomach, the gauze was found trailing through the stoma. We were immediately interested in this, because Cannon's observations had just been published. Unfortunately no record was made as to the direction taken by the tip of the gauze which had passed through the stoma. This is unfor-

tunate, because later observations suggest that solid bodies, which pass through the stoma, may all travel toward the pylorus.

During the past winter we determined to study this interesting problem of pyloric and stoma function and decided to investigate it from three standpoints, viz. (1) By studying the course taken by solid particles which were tied to a string. (2) By feeding fat and studying the condition of the lacteals an hour later. (3) By performing gastro-colostomy or gastro-ileostomy near to the valve and making observations upon the weight of the animal. For the feeding of string, no originality can be claimed, it having been used for many purposes notably by Abbe and Dunham. The particular purpose to which we have put it, however, we believe to be original. We conceived the idea that if gastroenterostomy were done and time allowed to elapse for the perfection of healing and for the establishment of any new physiological functions to which origin might be given by the operation, it would be fair to assume that solid food particles ordinarily passed on and digested, would take the same course as indigestible solid particles tied to string. The dogs accordingly underwent gastro-duodenostomy or gastro-jejunosomy, as the case might be, the technic being that of open incision and suture. Not less than two weeks later, they were permitted to swallow a piece of meat in which a small bullet, tied securely to the end of a piece of string, was embedded. A dog lends himself favorably to this manœuvre, because of his natural voracity. In an instant the meat, bullet and one end of the string are in his stomach. The next part of the procedure consists in anæsthetizing the animal to very profound narcosis. On separating the jaw very widely the pterygomaxillary ligament is brought clearly into view. The string being threaded on a short curved round needle is quickly passed through the ligament and tied. This should be done loosely so as not to cut through. Another point in the technic is that the string should not be tied to the meat: it being preferable probably to wrap it once or twice tightly around it.

The pterygo-maxillary ligament is situated so far aboral to the teeth that the animal does not bite the string off, and it remains hanging down the œsophagus. Its situation is so far

FIG. 1.



LINE DRAWING OF A SPECIMEN OBTAINED BY PERMITTING A DOG TO SWALLOW A PIECE OF STRING. BAG OF SHOT TIED TO END PASSED THROUGH THE STOMA, DUODENUM AND PYLORUS TWICE THE SAME FORCES MAY CARRY MURPHY BUTTONS FROM THE GUT INTO THE STOMACH.

STRING TIED IN PHARYNX TO PTERYGO-MAXILLARY LIGAMENT.

back in the pharynx that the string will remain for days in this position without creating any choking or discomfort of any kind whatsoever.

It is difficult to get the string to pass out of the stomach. If it is too long, it simply rolls up and lies in the stomach

imbedded in a mass of mucus and food. If too short, it will obviously not have the requisite length to give a demonstration of the facts under investigation. We are fortunate in having secured a specimen which Dr. Brown has mounted very beautifully, and of which both a photograph and a line drawing are shown in the illustrations Figs. I and II; it will be seen that the bag of shot passed directly into the stoma and instead of travelling aboral, it proceeded oral, Fig. II, toward the pylorus through it and into the stomach. Following the trail of string which it left behind, it can again be traced over exactly the same ground. This study appears to prove that at least under certain conditions and at certain times solid materials do pass through the stoma even when the pylorus is left untouched and it is in normal condition. This is further suggested by Fig. III, which shows a piece of *bone* lodged in the stoma. The results of further string feeding are shown in Fig. IV. This string passed direct through the pylorus. Thus some strings pass one way and some the other way. Figs. V and VI illustrate the same point.

Pyloro Stoma Function as Demonstrated by the Lymphatics.—We are fortunate in being able to report one case which lent itself very favorably to this demonstration. We had fed the dog string, and it had worn the string for the usual period of about 24 to 48 hours, when we determined to feed it fat prior to chloroforming it. About one hour after the fat meal, the animal was opened under profound anæsthesia. The gastro-ileostomy had been situated near to the ilio cecal valve, as shown in Fig. VII. By good fortune the mass of meat in which the string with its shot had been imbedded proved to be of a very indigestible type, and it was discovered considerably macerated but still in statu-quo lodged in the ileum about 20 centimeters oral to the stoma. The lymphatics of the duodenum from the very beginning of the mid gut, viz., some four to five centimeters aboral to the pylorus, were loaded and distended with emulsion. This, parenthetically, affords a convenient means of observing the similarity in function of the stomach and first portion of the duodenum from which no

FIG. II.



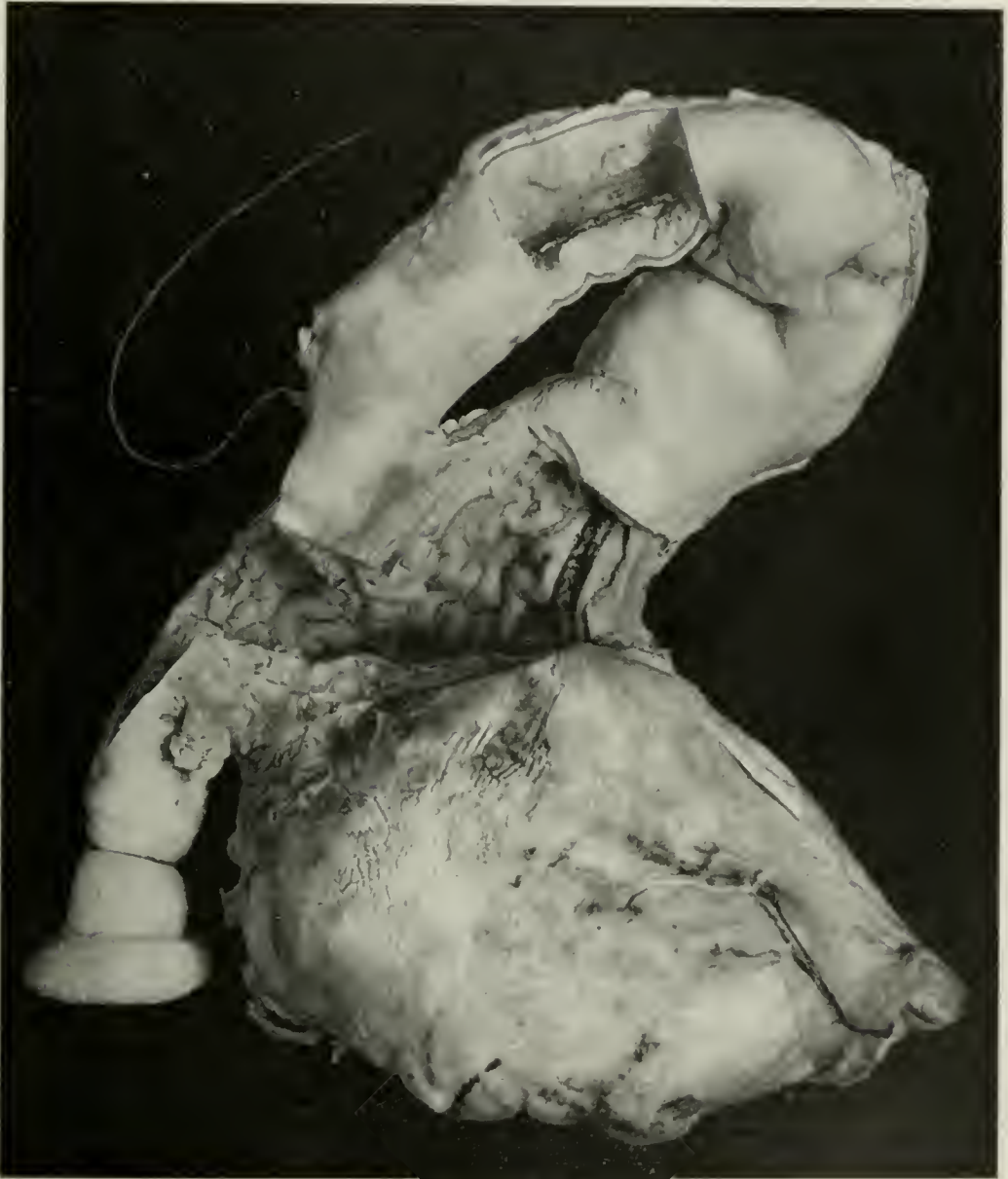
Photograph of specimen from which Fig. 1 was made.

FIG. III.



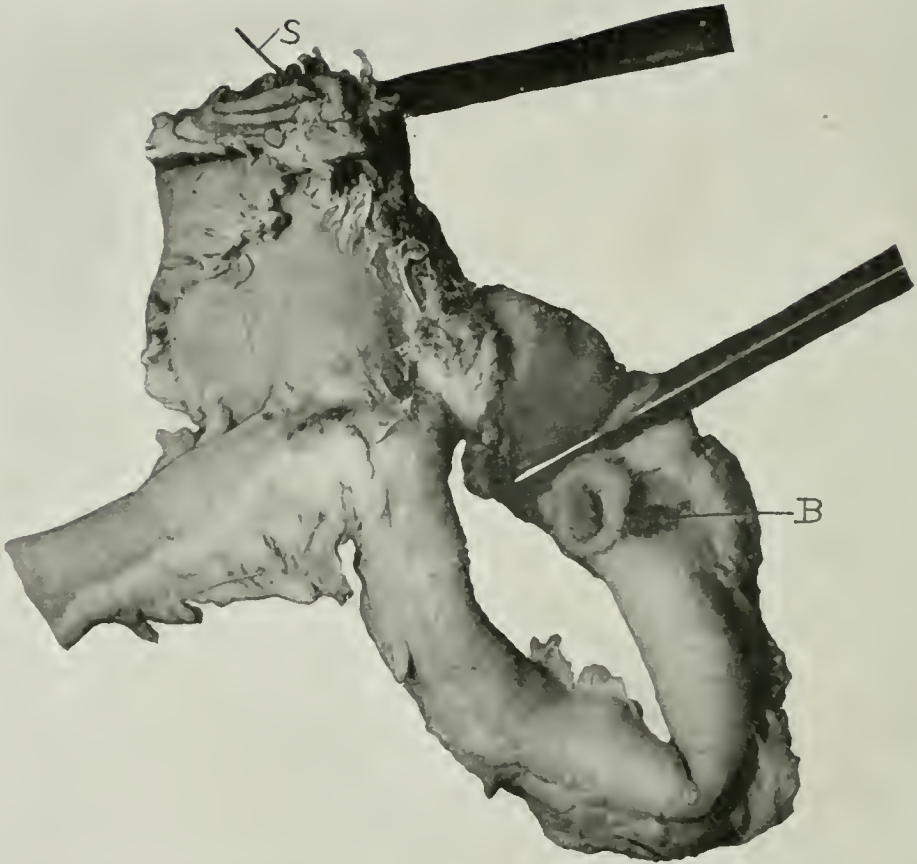
Studies in the Functions of the Pylorus.

FIG. IV.



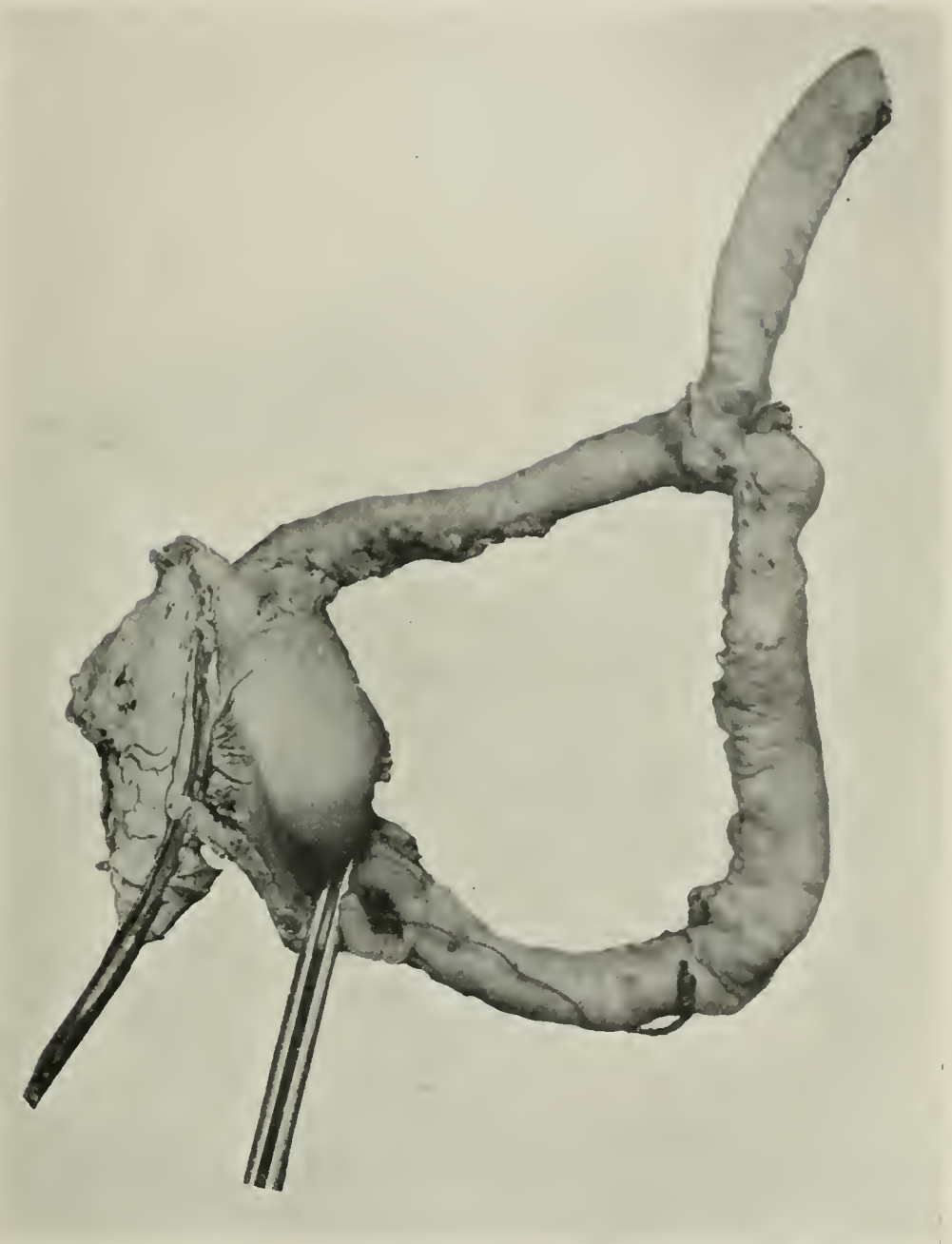
Studies on Functions of Pylorus, etc.

FIG. V.



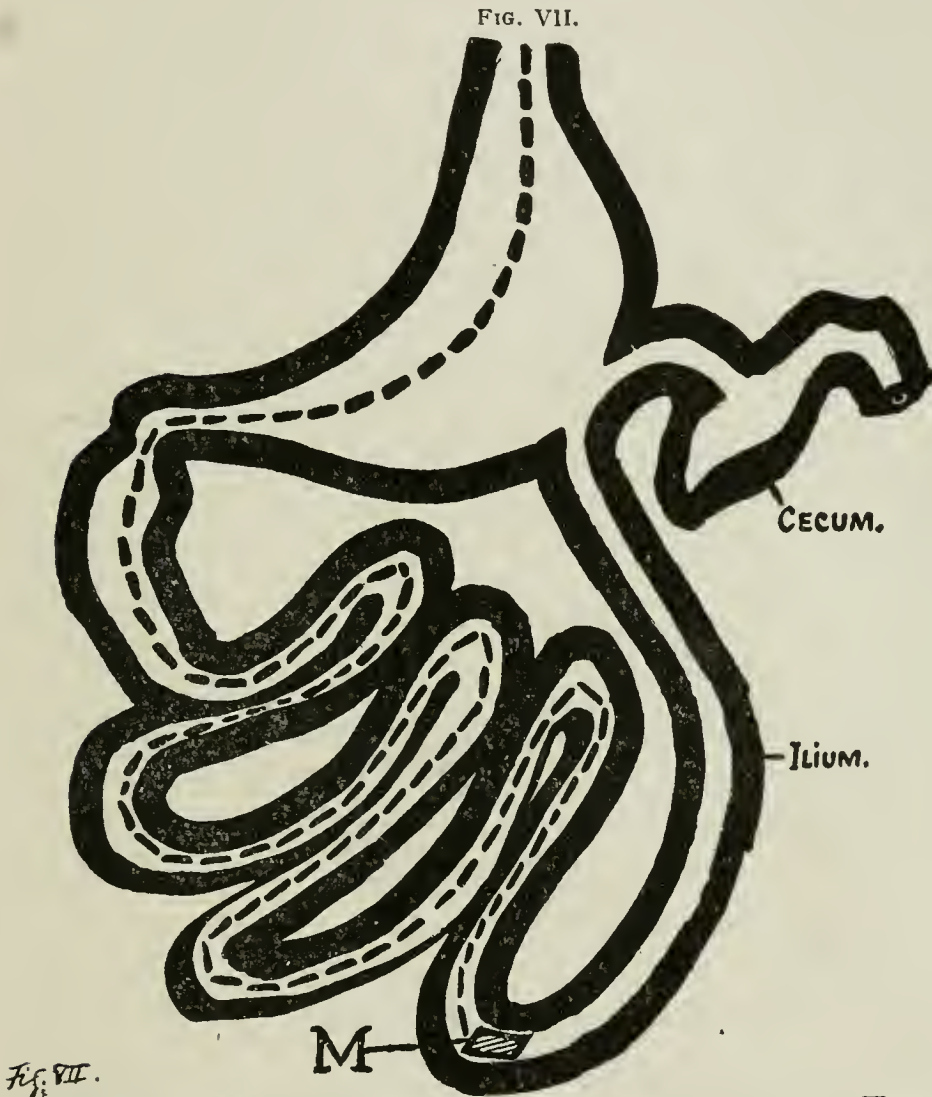
Photograph of specimen of gastro jejunostomy after string had been fed. The clamps were applied before specimen was removed so as to be certain that string was held in primary position. Note string at S; cesophagus and bullet on aboral end at B, where duodenum was cut.

FIG. VI.



Y gastro-enterostomy. Clamps applied as in Fig. V. Opening shows string which, with bullet, had passed through pylorus. This is suggestive for stoma drainage and was very perfect owing to end to side implantation of gut at stoma.

absorption whatsoever seemed to be taking place, two structures morphologically very dissimilar, but shown functionally to have a common origin in the primitive foregut.



THIS DOG SWALLOWED MEAT WITH STRING ATTACHED. TWO DAYS LATER WAS FED FAT. KILLED ONE HOUR LATER, LYMPHATICS ORAL TO POINT M, WHERE MEAT LODGED IN GUT, WERE GORGED. THOSE ABORAL TO M WERE EMPTY. PROVES THAT FATS DO NOT PASS THROUGH STOMA.

The lymphatics of the entire intestine from the second portion of the duodenum down were well filled. This lymphatic congestion terminated abruptly opposite the piece of meat which was lodged in the ileum and held there in place by

the string. On the aboral side, viz., for a distance of about 20 centimeters between the lodged meat and the stoma, it was positively demonstrated that no absorption whatsoever was taking place. Aboral to the stoma there was also no lymphatic engorgement. In this particular case, it therefore seemed that probably no fat had passed through the stoma; that all had gone through the pylorus. This, of course, presupposed that pancreatic secretion had passed beyond the meat.

These two studies are suggestive and are to be followed by more of a similar nature which are in course of preparation at the laboratory. It may well be that some slight variation in the technic as to length of loop, direction of incision in the stomach wall, position on anterior or posterior wall, mode of attachment of intestine to stomach and other even less significant factors may play parts at present entirely unknown in determining the function of the stoma in the presence of an unobstructed and natural pylorus. It has been thought (Mayo and others) that the stoma should be made at the most dependent portion of the stomach in order to functionate. This can be readily understood to be of great importance in the presence of atonic dilatation and pyloric obstruction. Our experiments, as yet incomplete, seem so far to show that the position of the stoma makes no difference in its function, at least we have not as yet been able to determine that it does.

Observations on Stoma Function by Recording the Weight of the Animal.—If a gastro-ileostomy be done very near the valve or if one goes so far as to perform gastro-colestomy, a study of the weight of the animal after this operation cannot fail to throw some interesting light upon the function of the stoma. Moreover observations on the feces are also not without importance, because if passed directly through the stoma, they would not have undergone digestive processes. Graphic charts of the weights of our animals have not yet been made, neither have the feces been examined microscopically or chemically. Gross examination however has as yet failed to show any difference in the feces of dogs operated on in this manner from those of unoperated dogs, and our observations

on weight appear to show that for a time after operation the dogs, usually thin and in rather poor condition, having been half starved on the streets, frequently gain in weight for about a week. They are then apt to lose weight rapidly for a week, and even though fed carefully with milk and dog biscuits, are prone to die at the end of the second or third week from inanition. Autopsy findings rather constantly show the long loop to be somewhat dilated and filled with soft grumous material. Pretty well marked spur formation at the side of the stoma has been a constant feature in these cases. Further study alone by means of feeding string and fat by the technic and at the times herebefore described will alone answer the question why these dogs should at first gain, then lose weight and why inanition and exitus should subvene so rapidly. It is not improbable that the profound nutritional changes that certainly do accompany many of these stoma experiments are due (Turck) to interference with normal colon bacillus action or to the establishment of chemical reaction unfavorable to digestion. In any event the experiments support Blake's contention that gastroenterostomy should not be done except in the presence of pyloric stenosis.

IS DEATH IN HIGH INTESTINAL OBSTRUCTION DUE TO THE ABSORPTION OF BILE? *

BY J. W. DRAPER MAURY, M.D.,

OF NEW YORK,

Fellow of the Rockefeller Institute.

IT is well known that acute intestinal obstruction occurring in the duodenum or oral portion of the jejunum is much more rapidly fatal than a similar obstruction occurring aboral to this portion of the intestine.

A rather careful study of the literature of the subject has failed to show that any definite cause has been discovered for this well known fact, everything to date being suppositional in character. So recent and so high an authority as M. Wilms, whose extensive monogram on ileus has just appeared, in discussing high intestinal obstruction says: "The time in which duodeno jejunal obstruction causes death has only in the rarest instances been prolonged. Death usually subvenes with extreme rapidity. All patients probably succumb to toxic absorption resulting from the decomposition of intestinal and stomach contents."

Starvation and lack of absorption of water, which has been thought by some to be a factor in producing the syndrome of duodeno jejunal obstruction, are hardly to be considered, particularly when one reflects that absorption of water takes place almost entirely from the colon and can therefore not be materially influenced by the position of the obstruction in the small gut. For, as Mayo says, we drink with our great gut and eat with our small. Wilms makes no mention of the possible relationship of the biliary and pancreatic fluids as a cause of death in duodeno jejunal obstruction.

Neither are these the only suggestions which have been offered as an explanation of the phenomena under discussion.

* A Research conducted under a Fellowship granted by the Rockefeller Institute.

Boszeky and Genersich offer two theories to explain the symptoms in intestinal obstruction, viz., reflex and auto intoxicational. They believe that bacteria and their toxins pass through the intestinal wall; that the slow pulse and other phenomena are caused by the interference with the vagi and splanchnics, which causes congestion of the abdominal organs, thus giving rise to anemia elsewhere, noticeably in the brain. The anuria which is characteristic of this condition is due in the opinion of these two authors to exhaustion of vaso dilators of kidneys and the drop in temperature to exhaustion of the heat centre, all due to cerebral anemia. "But," they continue, "in cases of obstruction by enteroliths, these symptoms cannot be explained on the ground of nervous phenomena. Here it must be chiefly an accumulation of feces and ptomaines and toxins due to *putrefaction of intestinal contents*."

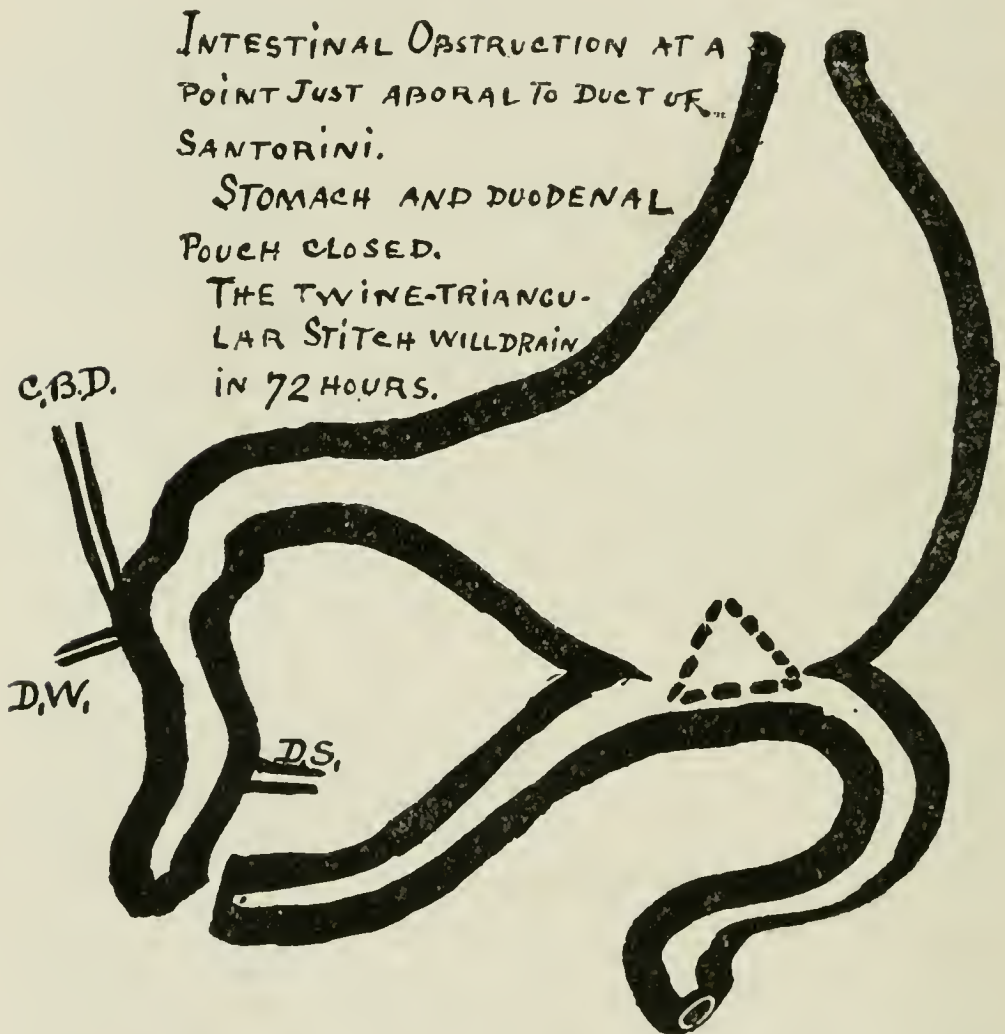
Here again in an exhaustive German monograph attention is called to the importance of putrefaction of the intestinal contents. Observations which we have made in the Laboratory show conclusively that putrefaction has nothing whatsoever to do with the cause of death in intestinal obstruction, at least when the seat of obstruction is within 35 centimeters of the pylorus.

Accidentally in the beginning, and, more recently, volitionally, we have studied this obscure but exceedingly important problem. It will be necessary in order to make our results clear, to give a short history of the manner in which the subject has been approached.

In a series of experiments conducted in the Surgical Research Laboratory of Columbia University and which were carried on to find some practical method of performing a gastroenterostomy by the so-called closed method, it was noticed that under certain constant conditions the animals operated on invariably suffered a similar train of symptoms which were always followed by a pseudo tetanic form of death. The pathological picture marked by fibrillary muscular twitchings, weakness and later rigidity is not unlike that presented after a parathyroidectomy. The conditions which

united to cause this precise form of death are shown in the accompanying outline (Fig. 1). They consisted in the performance of a gastroenterostomy by a closed method and the severance and closure of the short duodenal loop. The actual technic of effecting the establishment of the stoma is not of immediate concern here. It was made by what has been called

FIG. 1.



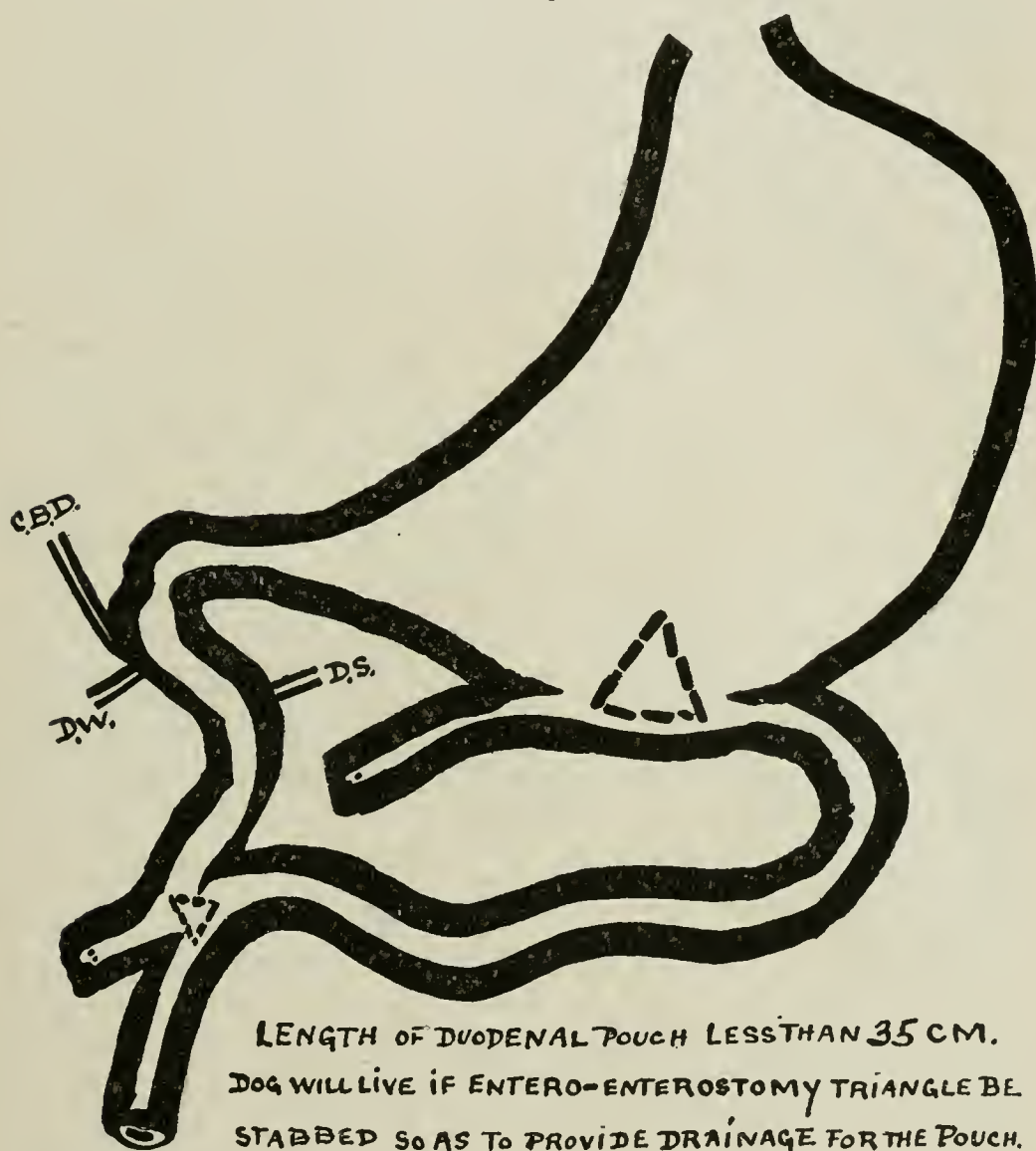
in previous communications the *twine triangular stitch*. It is necessary, however, to emphasize the fact that this triangular stitch, which is a simple substitute for the McGraw elastic ligature, has been introduced in all the series as a control. It is of great use for experimental purposes when it is desired to close the stomach for a constant number of hours and subse-



Intestinal obstruction. Photograph showing entero-anastomosis (open). Gastro-enterostomy triangular stitch (closed).
Animals live if loop be drained. Note the enteroliths which formed in end of intestinal pouch.

quently to have drainage re-established. The twine cuts a punched out opening at a period of from 70 to 100 hours. This varies in different subjects, but in long series a general average will be maintained. This is the first point to make clear.

FIG. 3.



In the second place, it was found that the length of the loop from the pylorus to the invagination was the essential factor in determining whether or not the animal would live. It was shown after many tests that if the distance from the infolding to the pylorus was less than 35 centimeters, it would die before

the twine triangular stitch gave drainage (70 to 100 hours). If the loop were longer, the animal would live.

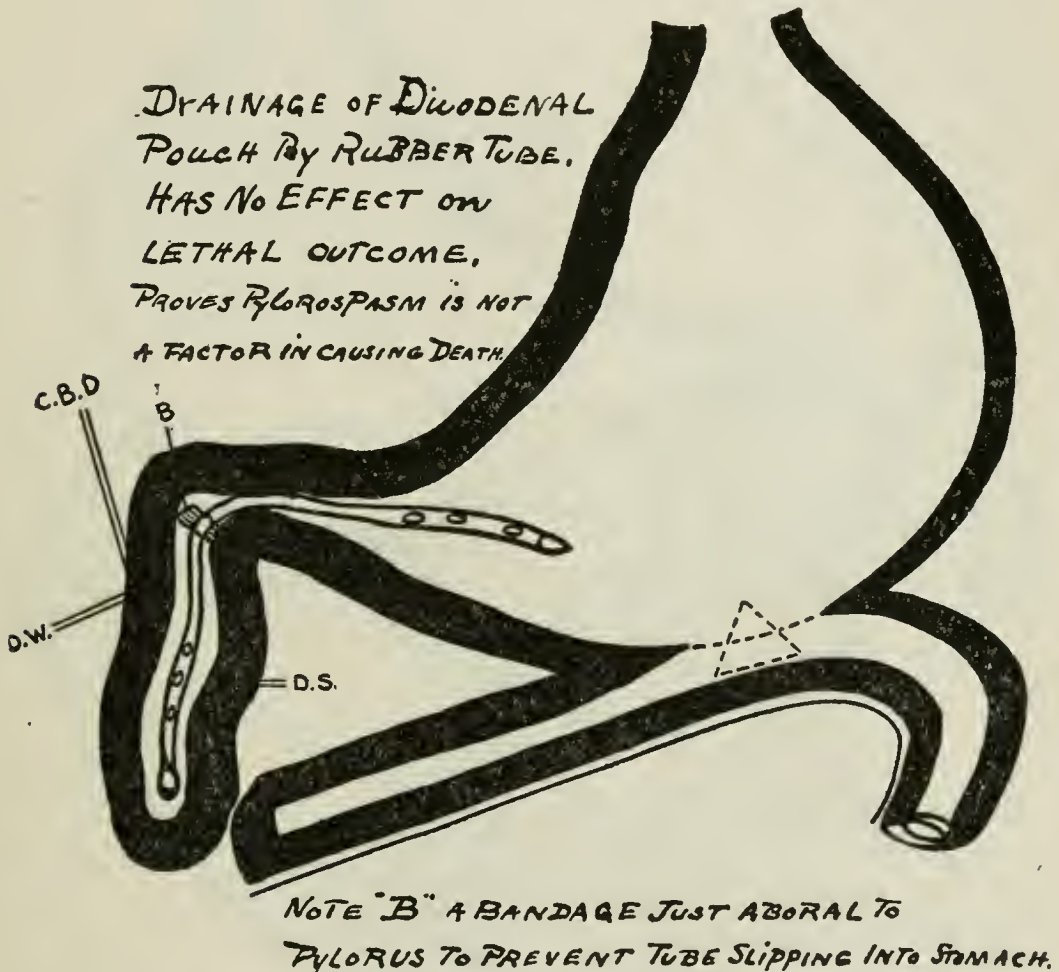
The third point is this: It was suggested by Dr. Flexner that this pseudo-tetanic death might be ascribed to decomposition of food materials in the stomach and duodenal loop. A number of experiments, however, upon fasting animals demonstrated that the presence or absence of food material in the stomach had no effect whatsoever in modifying the influence already alluded to of length of loop. Animals with stomachs well filled and those with alimentary canals thoroughly emptied showed no variation whatsoever in character or rapidity of death. The lethal line in either case was always approximately 35 centimeters from the pylorus.

There was a fourth point of importance. The question arose: Was the disturbance of innervation at the pylorus responsible for the death of the animal? A series of six dogs were operated on in the following manner. The pylorus was either sectioned or resected together with a small amount of stomach, and the ends infolded, great care being taken not to injure the bile duct. Twine triangular ligature was then inserted to create a gastroenterostomy. Without exception these animals lived until after the stoma had been established. This led to a most important conclusion. It showed that if the section and blockage of the duodenum were made oral to the bile duct, so that drainage were maintained for hepatic and pancreatic secretions, the animal would tolerate the absolute closure of the stomach without any ill effect until this viscus were drained by the establishment of the stoma 70 hours later. It is of great import to notice this, for it shows that, the nervous element owing to shock produced by section of the gut in the neighborhood of the pylorus, which has long been recognized to be a serious factor from a vital standpoint, in all operations in this neighborhood has absolutely nothing to do with this form of death which we have described as pseudo-tetanic. It suggests that the biliary or pancreatic secretions, or both, stand in some very definite relation to the lethal results observed. Pseudo-tetanic death occurring so constantly after section aboral to

these ducts and so rarely when the section was made oral to them, is indicative that some profound interruption of normal chemical processes in the intestine produces the fatal result rather than any nervous disturbance or shock.

It should be emphasized that the animals will live with a blocked loop less than 35 centimeters in length if the stoma be made an open one. Drainage of the stomach into the intestines

FIG. 4.



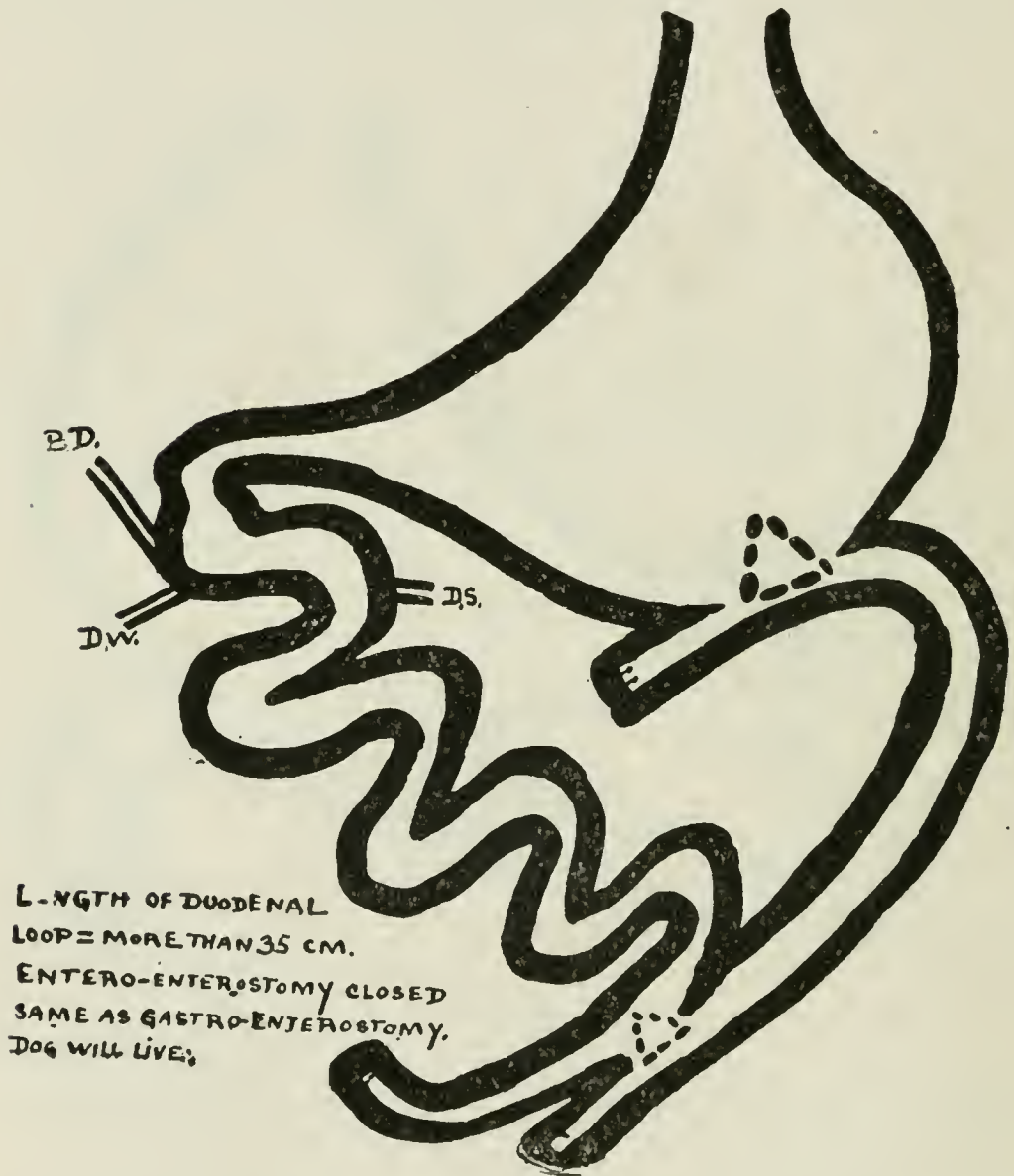
suffices to save the animal's life, no matter where the duodenum may be blocked.

It was further determined that the effect of entero-anastomosis between the jejunum just distal to the gastroenterostomy and the closed duodenal loop just aboral to the entrance of the ducts gave a similar result. Dogs operated on in this manner live. In other words, drainage of the loop is as

effectual in preventing the lethal results as is drainage of the stomach.

Moreover the fatal outcome is not the result of a closure of the loop produced by pylorospasm. The figure (4) shows how the proof of this was obtained. Rubber tubes placed so

FIG 5. .

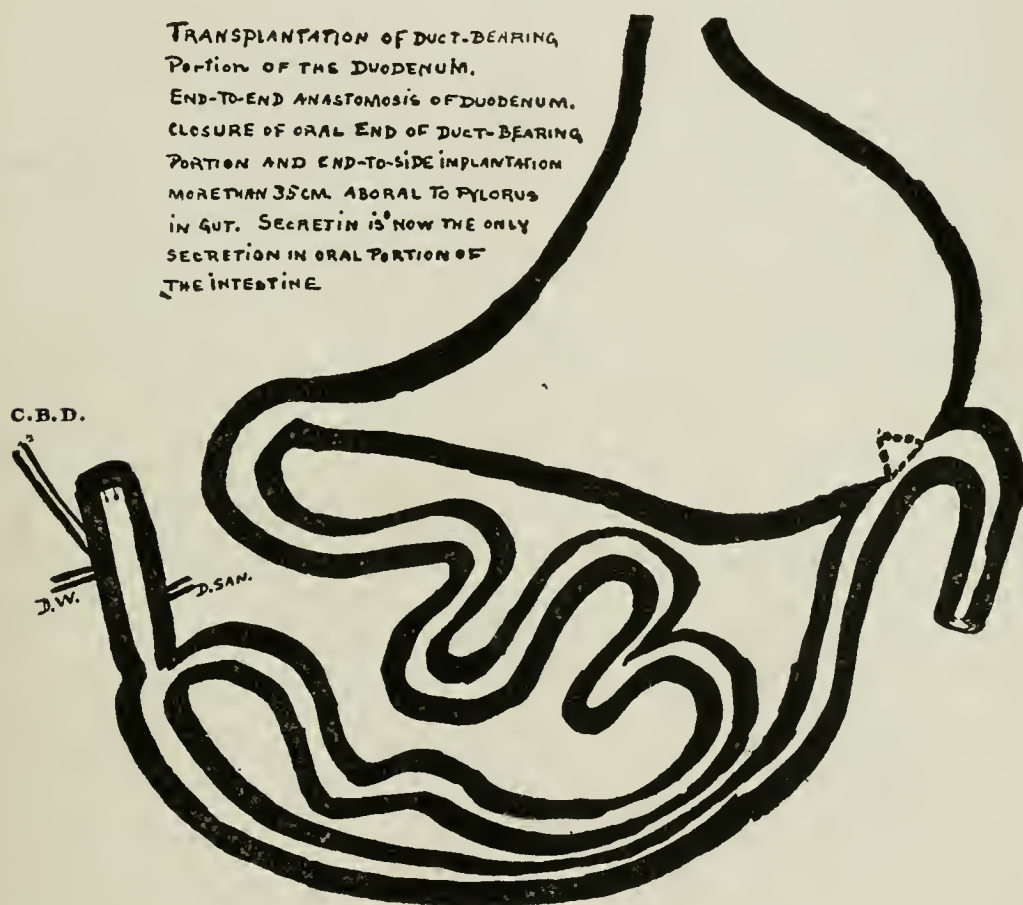


as to connect the loop with the stomach failed to be instrumental in preventing death. Drainage of the loop into the stomach is therefore shown to be without effect in preventing death.

Having eliminated nervous shock, as the source of lethal

impulse, as well as poisoning from food decomposition, obviously it became evident that the cause of death might lie in the production of poisonous substances produced by a mixture of the biliary and pancreatic secretions. It seemed possible, moreover, that this hypothesis might give us the real explanation of the fact that 35 centimeters or more of intestine in the closed duct-bearing portion sufficed to avert fatal results. For we may conceive that in this length of intestine such a quantity

FIG. 6.



of diluting material may constantly be furnished as would be adequate to render harmless the mixture alluded to. This supposition seems to be corroborated by the recent discovery of Flexner that the biliary salts, unless in colloidal suspension, act as violent poisons. He states (Jour. Exper. Med., 1896, p. 174) that the conclusion may be drawn that the suspension of bile in a bland mixture of high colloidal strength protects

the pancreas from the immediate and acutely injurious action of the biliary salts."

Further, on page 167, he continues: "Bile contains two sets of constituents of highly different chemical composition crystalline principals and colloids. The biliary salts are known to act injuriously upon the cells while no direct cellucidal property is known either for the biliary coloring matter or the mucin."

None the less convincing as to the toxicity of the bile are the studies of Meltzer and Salant. They state: (Jour. Exper. Med., 1906, 8, p. 159) "We have positive and direct proof that normal bile from many rabbits possesses an exciting element capable of producing chronic convulsions in frogs." Page 165, "that contrary to the prevailing opinion, bile contains a tetanic element or an agent which causes increase of excitability of the nervous system. That stagnant bile as in the gall bladder, etc., invariably produces coma and paralysis, that the depressive and exciting elements of the bile are mutual antagonists; that the depressive element when present in a highly effective dose is by far the stronger of the two, while on the other hand the tetanic element becomes effective apparently in a dose far below that which constitutes the minimum for the depressive element. That bile salts seem to contain the tetanic element in an extremely less amount than the whole bile."

Moreover and also in support of the supposition that a true auto intoxication from biliary or pancreatic products is responsible for death in high intestinal obstruction, we quote from *Opie* (Diseases of the Pancreas). He showed by a long series of experiments that the introduction of bile into the pancreas caused either death of the animal within twenty-four hours or widespread destruction of the gland depending upon the amount of bile injected.

As a means of further study of this question, Dr. Blake suggested the possibility of transplanting the duct-bearing portion of the duodenum into the intestine at varying distances from the stomach. This is accomplished by means of section between the bile duct and the pylorus of the first portion of the

duodenum and a second section of the duodenum aboral to the entrance of the duct of Wirsung. The segment of gut thus removed is carefully sponged out and wrapped in hot cloths. The ends of the pylorus and duodenum are then united by end to end suture. More than 35 centimeters aboral to the pylorus an end to side implantation of the segment is done, the oral end beside the bile duct having been carefully invaginated. This is a difficult operation, but it can be brought to successful issue. Dogs emaciate quite rapidly after it has been done, so that the most recent operations practised have included a section of the intestine just aboral to the implantation of the duct bearing segment, and a gastroenterostomy by means of the triangular stitch between the stomach and the gut aboral to the section. This, it will be noticed by consulting the figure, produces the same results from an operative standpoint as is shown in Fig. 1, except that the loop of intestine from the bile duct to the pylorus is more than 35 centimeters in one case, while in Fig. 1, it is not more than 10 or 12 centimeters. These experiments are not as yet concluded.

A simpler method of testing the effect of the presence of the secretions would naturally be to tie the pancreatic ducts and the bile duct. This is easier from a technical standpoint, but of course it does not produce conditions in any way resembling the normal as does the transplantation technic already referred to. Nevertheless in a number of experiments, both the ducts of Santorini and of Wirsung have been tied as well as the bile duct. This series is not yet far enough advanced to enable us to make a report upon it. Some of the dogs have died and on autopsy the pancreas has been found to be exceedingly hard, while the omentum has been dotted with unmistakable areas of fat necrosis. This gross evidence of pancreatic lesion has not been observed in our cases of pseudo-tetanic death occurring after duodenal section and infolding just aboral to the ducts. It suggests therefore that the form of death in the one case may have been different from that in the other.

In another series of experiments, the bile duct alone has

been tied with two ligatures and divided between them. Here again the series is as yet too short to enable us to make any positive statements, but several dogs in which the bile ducts were cut, have lived with a short duodenal pouch and twine triangular stoma.

A method for transplanting the point of bile entrance beyond the 35 cm. line and one less difficult as well as less apt to be accompanied by adventitious pathological conditions such as fat necrosis is a simple chole cystenterostomy. This has the added advantage of separating the bile and pancreatic secretion. It is not easy to do this operation in two steps because of the formation of troublesome adhesions and done at one sitting, prolonged as it must be by gut section and infolding and by the triangular enterostomy, there is danger of death from shock or later by peritonitis from leakage. We have done two of these one-stage operations without a death by shock, but followed by fatal peritonitis on the fourth day. The third dog lived three weeks, and was killed to obtain the specimen shown in Fig. 7. It is immaterial that the animals died of peritonitis—the point of interest is that they survived beyond the time which would have been possible had the bile been passing down its normal channel.

MacCallum of Johns Hopkins who, with associates, has given us a most elaborate and exact study on ileus inclines to the belief that death is due to the absorption of bacterial toxines, which enter through the impaired gut wall. Clinically Mayo and others have confirmed this assumption by observing a lowered mortality to follow a wide resection of the dilated gut. Nevertheless it seems noteworthy, first, that total exclusions of gut segments may be made which, left in the abdominal cavity gradually grow to great size (see paper of Blake & Brown in this issue) without producing any signs of toxemia; second, that this work has been done in the relatively germ-free portion of the gut; third, that obstruction is tolerated during the cutting out of the control if placed oral to the bile duct while it always is fatal before the control cuts out, if situated aboral to it.

FIG. 7.



Photograph of specimen obtained from a dog in which acute duodenal obstruction was established. Cholecystenterostomy and twine triangular gastro-enterostomy and section of common duct were done at same time. Pancreatic ducts intact. Dog appears to have lived because of transplantation of the bile from duodenum into ilium. 1, Duodenal pouch. 2, Infolded aboral end. 3, Pancreas. 4, Site of stoma. 5, Cholecystenterostomy. 6, Cut end of common duct. 7, Cecum. 8, Remnants of liver. Mounted by Dr. Brown.

In conclusion it may be said that so far as our experiments go, there seems reasonable ground to believe that they demonstrate that death in duodeno-jejunal obstruction may be due to the absorption of toxic elements in the bile which are normally rendered harmless by dilution and colloidal suspension in the secretions of the small intestine. That as the length of small intestine from the bile duct to the site of obstruction decreases, so the diluting secretions decrease and the toxicity rises proportionately. That if further experimentation definitely proves that bile is directly the cause of death in certain forms of intestinal obstruction, it may be possible to lower the operative mortality. For a knowledge of the pathology of a condition is the first step toward the establishment of a successful mode of treatment.

STUDIES IN INTESTINAL EXCLUSION.*

BY JOSEPH A. BLAKE, M.D.,

AND

R. M. BROWN, M.D.,

OF NEW YORK.

From the Laboratory for Surgical Research, Columbia University.

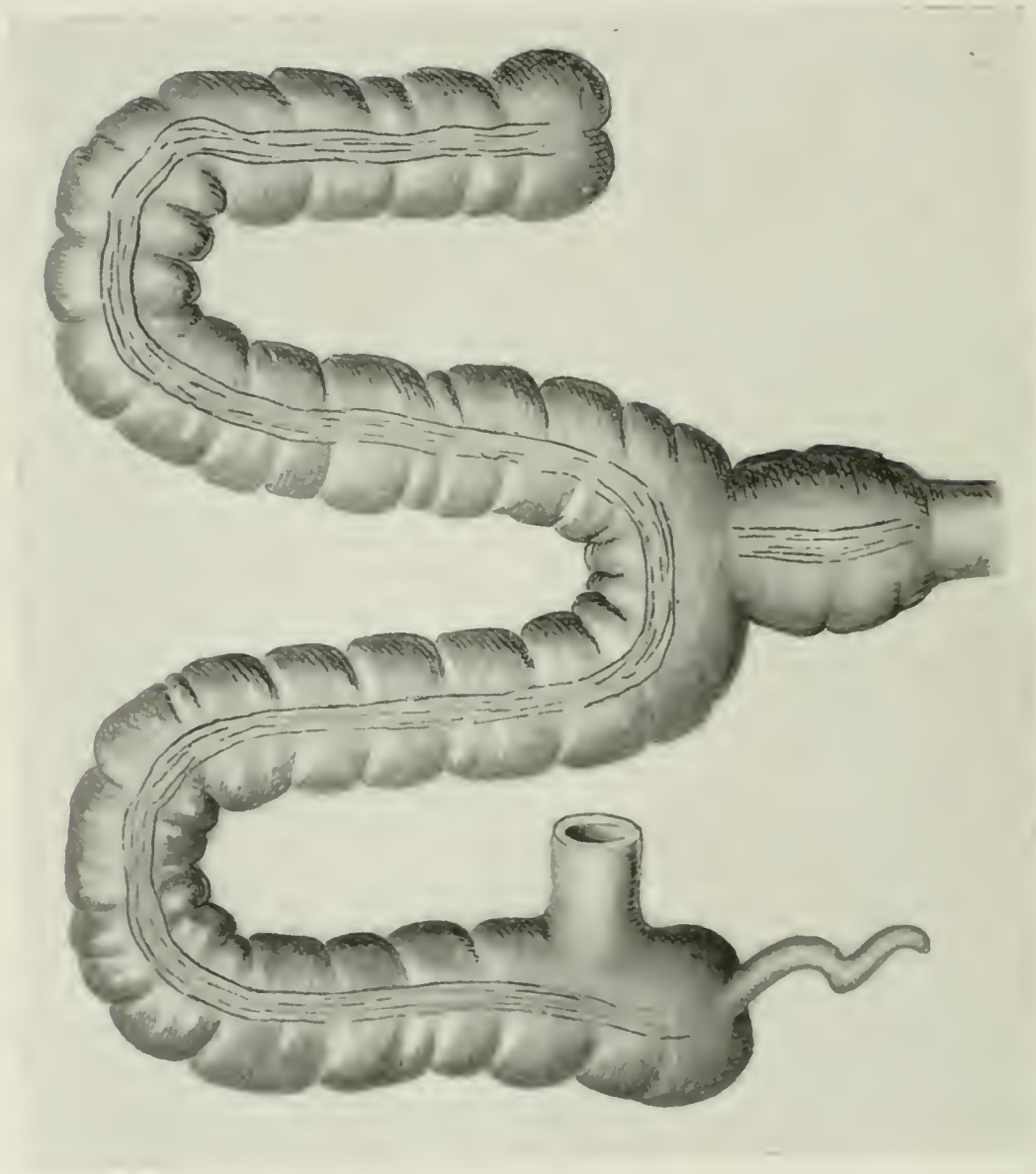
THESE studies were prompted by an operation upon a patient of one of the writers in whom, in order to reestablish the continuity of the large intestine after the resection of the sigmoid flexure, an unusual anastomosis was employed.

The patient, a man fifty-six years of age, was operated on June 11th, 1906, for intestinal obstruction caused by what was supposed to be carcinoma of the sigmoid flexure but was afterwards proven to be hyperplastic tuberculosis. At operation the entire sigmoid flexure was found to be implicated in a mass which also invaded the bladder and the left spermatic cord. In order to remove it, it was necessary to sacrifice a portion of the descending and the upper part of the pelvic colon. The hiatus was so great that the ends could not be brought together without exerting undue tension, consequently the upper end of the remaining portion of the pelvic colon was implanted into the side of the middle of the transverse colon. This resulted in the formation of a blind pouch or cecum distal to the anastomosis (Fig. 1). The arrangement may be termed a unilateral aboral exclusion. It was recognized at the time to be faulty but the patient's condition precluded further interference and there was no certainty that it would provoke serious trouble.

The immediate convalescence from the operation was perfectly smooth and the patient gained twenty-eight pounds in the following two months. During this time he complained at times of colicky pains and there seemed to be accumulations of gas

* This and the eight accompanying papers by Drs. Eggers, Greene, Leggett, Maury, Blake, and Beer represent the results of studies conducted during the session 1906-07, in the Laboratory for Surgical Research, College of Physicians and Surgeons, Columbia University.

FIG. 1



Implantation of oral end of remaining portion of pelvic colon into side of transverse colon. The portion of the colon distal to the anastomosis is aborally excluded.

and fecal matter in the excluded loop. This could be relieved by irrigations with a long rectal tube. Excision and division of the loop were considered but were not advised on account of the

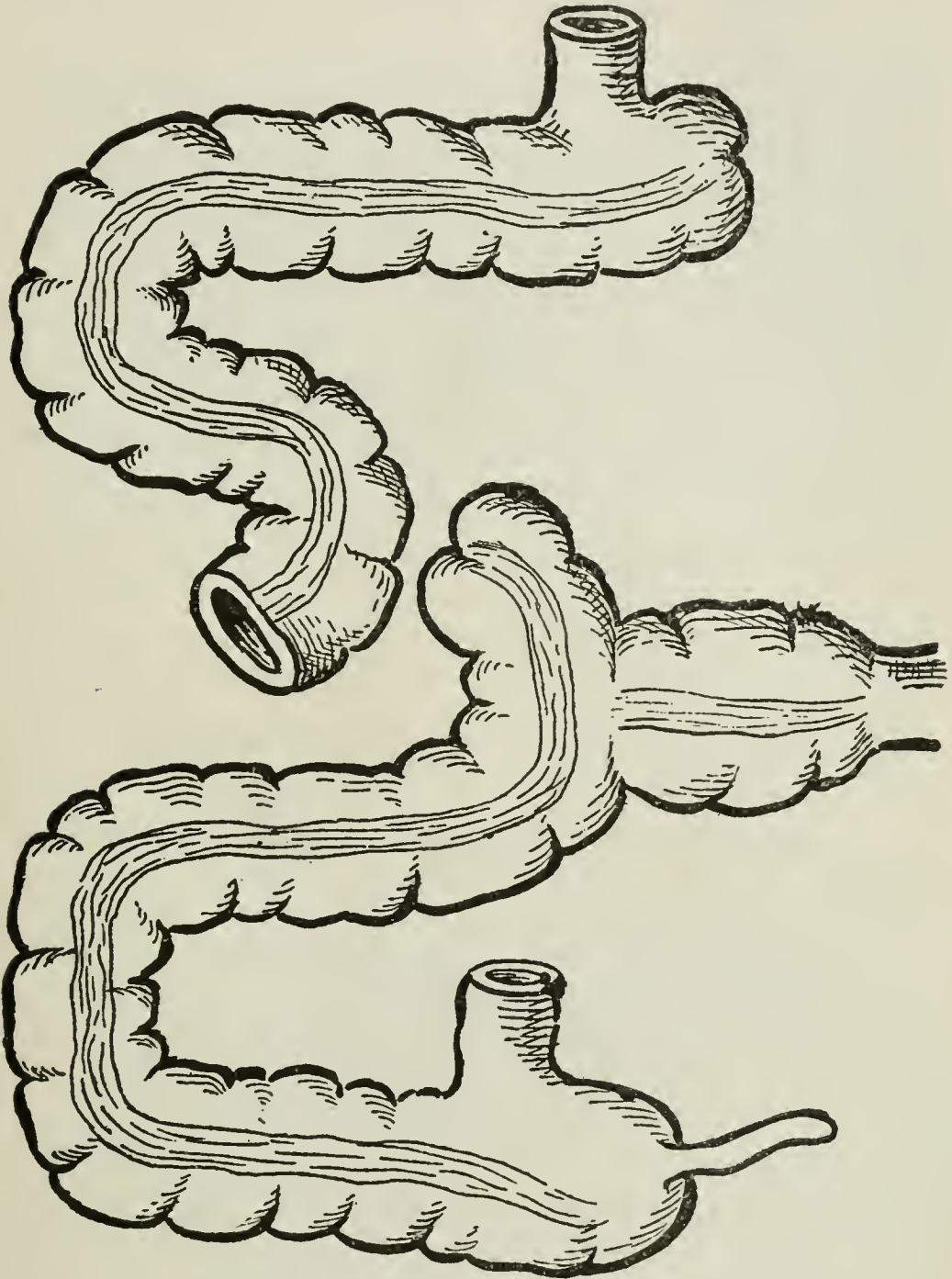


FIG. 2.—Showing arrangement after division of aboral segment and closure of proximal end. The totally excluded loop now communicates with the exterior at both ends; the distal opening being the one formed by spontaneous rupture.

continued improvement of the patient. In the meantime, he went to his home in a neighboring city and resumed his business.

During the winter the trouble from accumulation in the blind end increased necessitating daily irrigations and finally, at the end of January, 1907, perforation at the blind end occurred with the formation of an abscess. This was opened at Atlantic City. After remaining there for some weeks, he was brought to New York with a narrow sinus discharging pus, gas and fecal matter. The discharge occurred more or less intermittently and at times would be accompanied by sharp colicky pain due to the peristaltic efforts of the loop to empty itself. The patient's general condition was bad, he had lost much weight and was running a low grade septic fever. By increasing the drainage his condition was improved and on April 15, 1907, ten months after the first operation, the transverse colon was divided just distal to the anastomosis with the pelvic colon, the proximal end was closed and the distal end brought up into the incision (Fig. 2). The operation was exceedingly difficult on account of the adhesions. The loop now is a bilateral exclusion with a proximal opening; the distal end communicating with the skin by the fistulous tract. Water injected into the proximal end, escapes at once from the fistula but when injected into the fistula it does not escape from the proximal end, showing that it does not readily pass against peristalsis. Four months after the operation, the sinus communicating with the proximal end of the excluded loop barely admits a No. 12 French catheter and there is no discharge from it. The distal end is also open and communicates with a fistulous tract leading to the point where the intestine was closed just beyond the anastomosis. The discharge being mingled with a small amount of feces escaping from the latter its character and amount cannot be determined. However, as far as can be ascertained, the excluded loop has contracted so that it will hold only about an ounce of fluid.

The necessity for anastomosing the pelvic into the transverse colon seldom occurs. An extended search of the rather voluminous literature of intestinal anastomosis and exclusion failed to reveal a similar instance. As a rule, obstructing growths of the sigmoid flexure do not involve an extent so great as not to permit of end to end union after resection. Not having data derived from former cases and anticipating

FIG. 3.

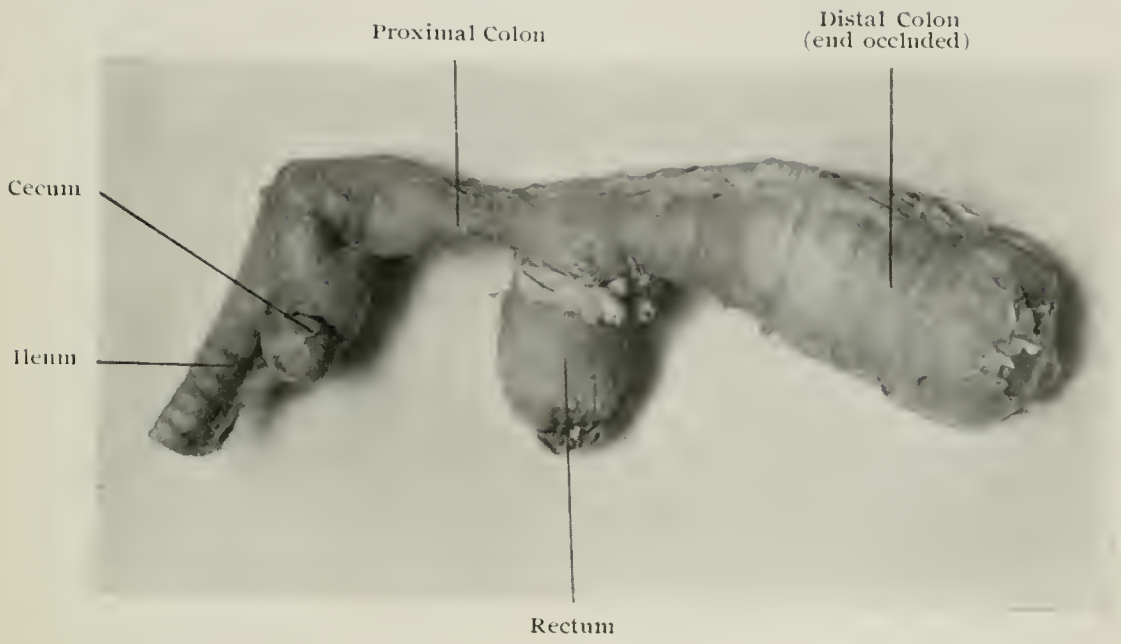
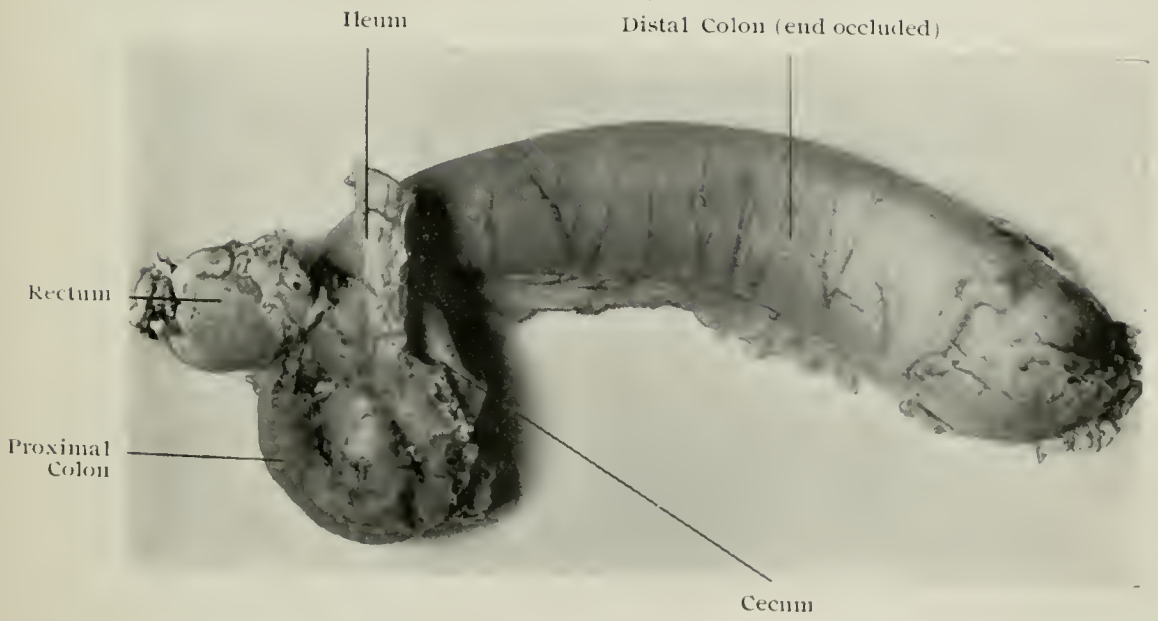
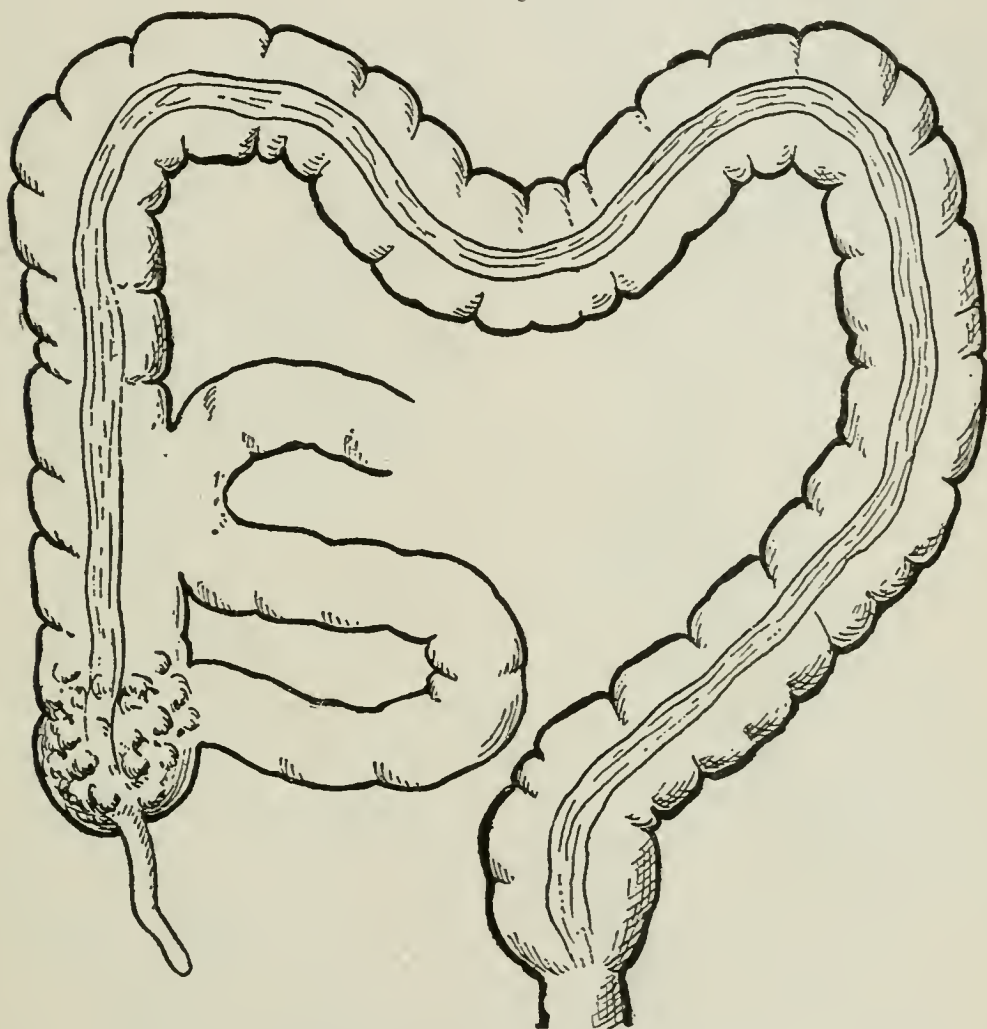


FIG. 4.



trouble from accumulation in the distal blind segment, similar operations were performed on dogs, the large intestine being divided just above the rectum, the oral end completely closed and the aboral end united end to side to the large intestine just distal to the ileocecal junction. The first dog was operated on November 19, 1906, and no adverse symptoms,

FIG. 5.



Lateral anastomosis between the ileum and ascending colon, for the purpose of shunting the intestinal contents by an obstruction in the cecum.

excepting a temporary diarrhœa, being noted, the operation was repeated on another on February 7, 1907. This dog also suffered from diarrhœa for several weeks after the operation. On April 27, 1907, both dogs were killed.

Examination of the blind intestine beyond the anastomosis showed that the intestinal contents had been crowded toward

the closed end dilating it to more than twice its normal diameter. Just beyond the anastomosis the diameter was practically normal which increased from there on to its maximum at the blind extremity (Figs. 3 and 4). After a greater

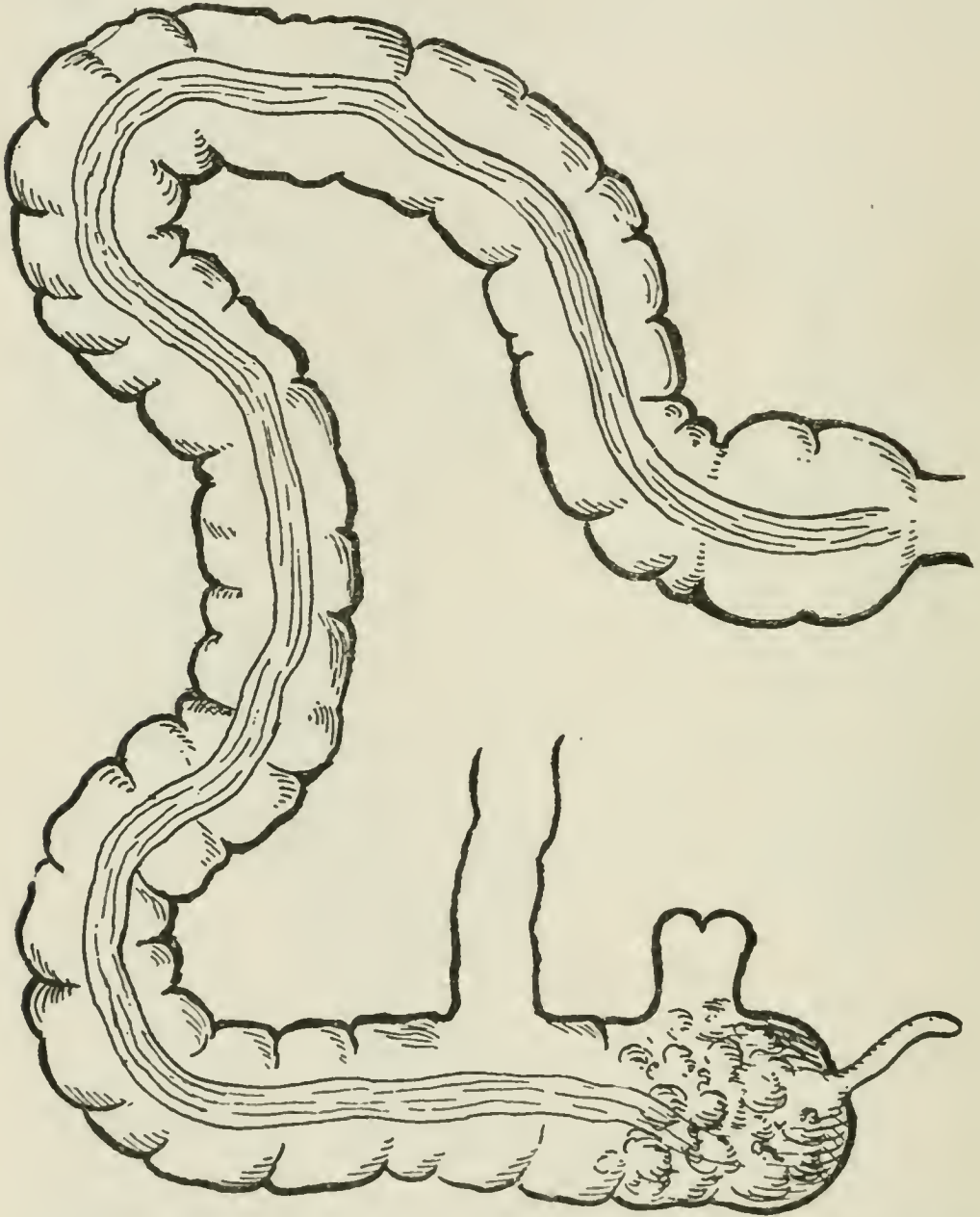
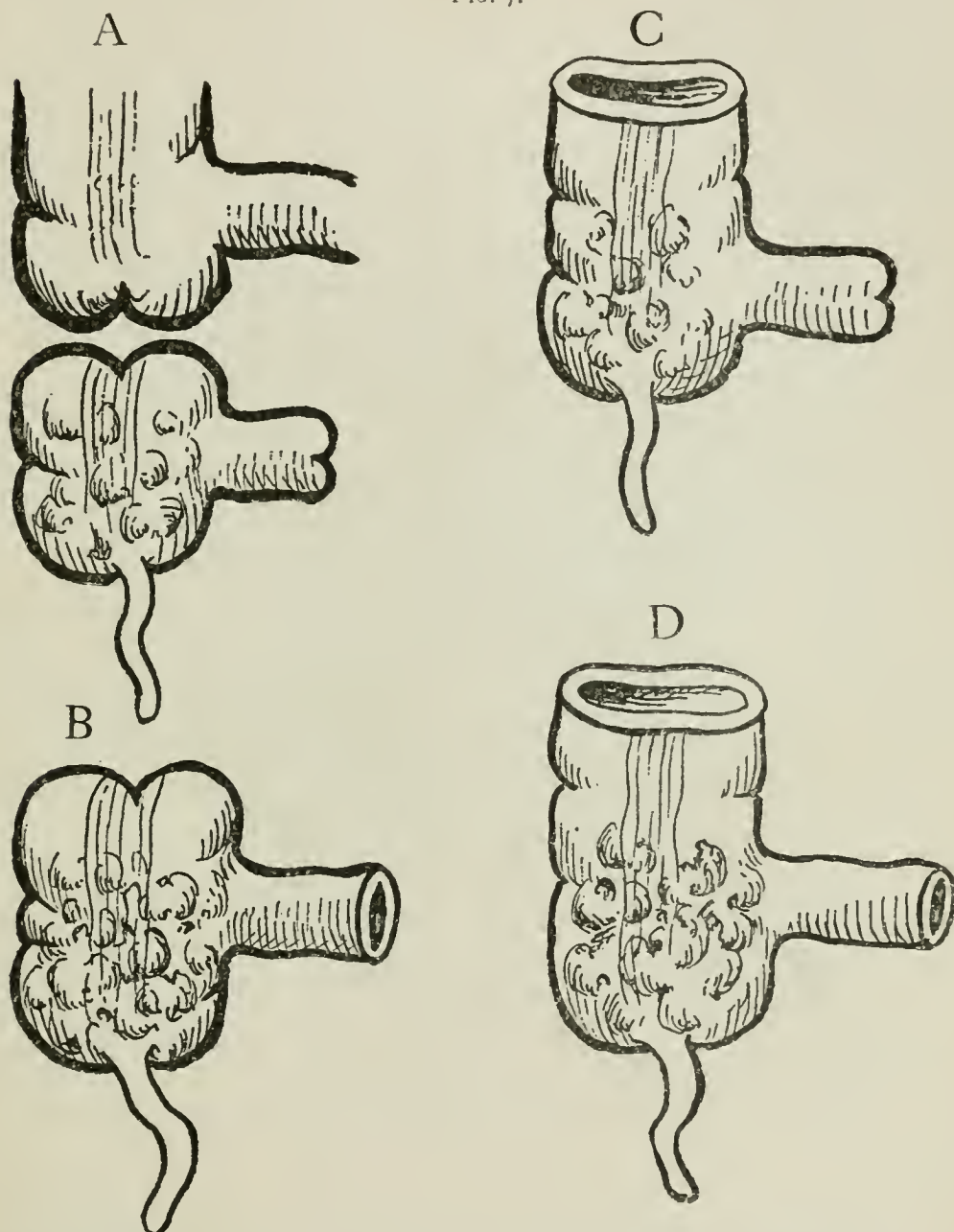


FIG. 6.—End to side implantation of ileum into ascending colon with occlusion of distal end of ileum. The segment comprising the distal portion of the ileum and the cecum is unilaterally or incompletely excluded and is unilaterally occluded.

lapse of time it is probable that perforation would have occurred in the dogs as it did in the man, either from ulceration or penetration by some foreign body accidentally ingested.

The results of the operation upon the patient and the dogs show that aboral partial exclusion of the intestine is a faulty and dangerous procedure. If the excluded segment cannot be

FIG. 7.



Bilateral or complete exclusion, with A, total occlusion B, distal occlusion; C, proximal occlusion and D, both ends open and attached to skin.

excised, it should at least be totally excluded as was accomplished by the second operation in the case reported.

The objectionable features of such operations also apply to the ordinary lateral anastomosis performed to shunt the

intestinal contents by a diseased segment of gut. In such cases, if the obstruction is complete, accumulation occurs in that portion of the excluded loop which is proximal to the obstruction (Fig. 5). This objection has been recognized for a long time although its dangers have not been fully appreciated. In cases of fistula or when, for any reason, the presence of feces in the excluded loop is objectionable, lateral anastomosis is a complete failure inasmuch as the feces are not prevented from passing into it. For these reasons the end to side anastomosis resulting in a unilateral exclusion as recommended by Senn, is preferable (Fig. 6). Even when this operation is performed, fecal matter gathers to a certain extent, in the excluded segment on account of the double direction of the peristaltic movements in the large intestine, and if this is undesirable, complete exclusion as recommended by Salzer, should be performed; at least one end, preferably the distal, of the excluded loop being united to the skin (Fig. 7).

Unless one or both ends of a completely excluded loop communicate with the skin, or a communication exists by means of a fistula, troublesome accumulation is apt to occur. According to Reichel (*Centralblatt f. Chirurgie*, Bd. 22, S. 37) in experiments on animals, accumulation may or may not occur. Obalinski states (*Centralblatt f. Chirurgie*, Bd. 22, S. 129) that complete exclusion with total occlusion of the large intestine is safe but of the small intestine is dangerous on account of the preponderance of the secretory over the absorptive functions of the latter. According to Wiessinger (*Deutsche Zeitschrift f. Chirurgie*, Br. 62, S. 1) only one of four cases of complete exclusion with total occlusion was successful up to 1901, either rupture occurring with fistulous formation or death.

In order to determine the safety of complete exclusion combined with total occlusion of the large intestine, a series of five experiments were made on dogs. Two of the animals died of peritonitis immediately following the operation and the identity of one was lost leaving only two in which the result could be observed. One of these was killed four weeks

FIG. 8.



Photograph $\frac{2}{3}$ natural size of completely excluded and occluded large intestine.

FIG. 9.



after the operation and the excluded segment was found to be distended with what was apparently fecal matter, to three times its normal diameter (Fig. 8). On section the walls were hypertrophic rather than thinned. The other animal was killed three weeks after operation and the result is well shown in Fig. 9. The photograph was taken one-half hour after the removal of the specimen and shows peristaltic contractions still taking place in the excluded segment. It is also interesting to note that the distal end is more distended than the proximal as a result of the peristalsis. The result of these experiments indicates that total occlusion, even of the large intestine is dangerous on account of distension of the segment by the excretions of the intestine. They also indicate that distal occlusion has the same effect upon the excluded loop as any obstruction has upon the intestine in general, namely, in increasing peristalsis and causing hypertrophy of the muscularis.

During the coming Winter further investigations will be carried out to ascertain the morphological and chemical nature of the semi-solid matter found in the excluded intestine. Its rapid accumulation is confirmatory of the theory that at least a large portion of the feces is excreted by the intestinal mucosa and that the function of the large intestine is not entirely absorptive.

ARE THE INTESTINES ABLE TO PROPEL THEIR CONTENTS IN AN ANTI-PERISTALTIC DIRECTION? *

BY EDWIN BEER, M.D.,

AND

CARL EGGERS, M.D.,

OF NEW YORK.

IN the following pages we wish to bring together some of the evidence in favor of an affirmative answer to the above query. The evidence in favor of such an anti-peristaltic movement is both clinical and experimental. How frequently under normal conditions such movements do occur in the human intestine remains to be determined by future investigation. Here we are concerned only with the question, can the intestines propel their contents in an anti-peristaltic direction?

That this question is not altogether simple is evident. That it is not settled will be readily gathered from the statements to be quoted from recent authoritative writers. In Wilms' book on Ileus just published (on p. 26) he states, "An anti-peristalsis, that is, an evident upward peristalsis driving the contents of the bowel towards the pylorus, and not towards the anus, does not occur." On the other hand, W. J. Mayo, *American Journal of the Medical Sciences*, January, 1907 (p. 4), states, "The normal action of the upper colon is anti-peristaltic except during defecation," and further, "Murphy has shown that salines introduced very slowly into the rectum will be absorbed with great rapidity, largely by reverse peristalsis to the cecum." These opposed views, recently expressed, show the need of further study along these lines, and we trust that the following array of evidence will convince

* From the Surgical Research Laboratory, College of Physicians and Surgeons, Columbia University. Presented in part at the New York Academy of Medicine, May, 1907.

many who at present agree with Wilms' in his statement of the case.

Before discussing the evidence gleaned from experiments in the laboratory, and from observations in the clinic, we must briefly analyze a phenomenon which in all probability does not concern this study. If some non-absorbable powder, such as carmine, be placed within the rectum of a patient with a colostomy opening, and smears be made from this artificial anus, one will almost regularly find, in a shorter or a longer time, granules of this powder. In other words, this carmine has wandered from the rectum up the bowel and out through the colostomy wound. This curious phenomenon can be observed by any one in such clinical material as above referred to, or in laboratory animals if desired. At first blush it looks like an affirmative reply to the question before us, for the contents of the rectum have wandered upwards in an anti-peristaltic direction. Perhaps in due time this phenomenon may be adequately explained. At present almost all investigators are inclined to interpret this upward wandering of carmine from the rectum to the colon, or even to the stomach or higher, as due to upward currents along the intestinal wall, quite independent of peristalsis. The fact that this phenomenon occurs despite stenoses of the bowel, the carmine wandering through these rigid parts, and the fact that intestinal quiet favors the ascent of the carmine seem to exclude this from the group of phenomena which point to the possibility of anti-peristaltic activity in the intestine. The final verdict, however, has not been reached as yet.

Of direct bearing on the question before us, are two groups of observations—the one gathered in the laboratory and the other in the clinic. Both are of great importance, and both must be analyzed carefully. The experimental work is the more important as the observations are fuller and perhaps more accurate, and these we shall take up first, leaving clinical evidence for later consideration.

There are two experimental methods of approaching the problem as to whether the intestine is capable of propelling its

contents in the reversed or anastaltic direction, and in our work, which has been in progress almost $1\frac{1}{2}$ years, we have employed only one of these, and that which seemed to promise most to us. Instead of employing the method of direct observation of the unoperated bowel, with or without the use of the X-rays we have used the operative or functional method of testing the capacity of the intestine for working in the reversed direction, by resecting segments in the small and large bowel, turning them around, and sewing them in place in reverse position. If the bowel is capable of propelling food in the reverse direction, then this reversed piece of intestine will function isoperistaltically; in other words its normal downward peristalsis will give way from time to time, or altogether to what would, under normal conditions, be anti-peristalsis. Thus we would acquire rather conclusive proof that the intestine is capable of doing anti-peristaltic work, of accomplishing what Wilms so recently denied.

This method of approaching our problem is by no means original, as in 1889, Kirstein attacked the question of anti-peristalsis in just this way. Since his publication many others have repeated his experiments (Mall, Edmunds and Balance, Muehsam, Kelling, Kauders, Enderlen and Hess, Prutz and Ellinger), but the lack of uniformity in results has occasioned considerable confusion.

Wilms' recent statement that, "in the experiments of Prutz and Ellinger, who have again carefully analyzed the anti-peristaltic intestinal movements, it is conclusively proven that the reversed segment shows the same peristalsis as before reversal, and that no real anti-peristalsis develops," fails to throw any light on this subject; in fact in our opinion, adds to the difficulties already existing. A brief review of the published work, and a careful analysis of Prutz and Ellinger's experiments will show, we believe, how erroneous Wilms' conclusion is.

In our opinion, the most satisfactory method of arriving at well-founded conclusions in these reversal experiments is by the direct study of the behavior of the reversed loops. That

is the only sure way of deciding in which direction the peristaltic waves progress. A second, but less accurate and decidedly inferential method of arriving at valid conclusions, is that in which reversals of extensive segments of the bowel are made. In such animals, regular defecations must be the sign of downward or katastaltic waves, as one cannot conceive of the intestinal contents traversing very large segments of reversed bowel towards the anus, unless the peristaltic waves propel them in that direction.

With these two methods and view points in mind, let us briefly review the work done along these lines, and then take up our own experiments which were done in part by ourselves, and in part by the students of the College of Physicians and Surgeons under the careful supervision of Dr. Maury.

*A. Kirstein*¹—1889—operated on two dogs, reversing segments of the small intestine. He attempted a direct study of the peristalsis in one of his animals, but his attempt was unsuccessful. He noted at autopsy, the animals being killed 7 weeks and 3 months, respectively, after the operation, that at the upper anastomosis there was a spindle shaped dilatation with hypertrophy extending above and below the upper end to end anastomosis, and bisected by this. This dilatation he explained as the result of the two peristaltic waves working against each other. He concluded, with perfect propriety, that the peristalsis in the reversed gut must be reversed at least from time to time, to allow of the downward passage of intestinal contents through a reversed segment, which was $\frac{1}{4}$ of the length of the total small bowel, as in his second experiment.

*Mall's*² work was done about the same time as Kirstein's. He also found that at the upper anastomosis there regularly developed dilatation and hypertrophy, and that in this spindle shaped area, hard foreign bodies tended to collect, though some glass balls fed to such an animal passed through the whole alimentary tract. Faradic stimulation (2 mos. p. op.) in one

¹ Deutsche Medizinische Wochenschrift, p. 1000, 1889.

² Johns Hopkins Hospital Reports, p. 93, 1896.

case in which he employed it, showed no reversal of the peristaltic waves.

*F. Kauders*³—1893—repeated these reversal experiments in cats, but failed to obtain any adequate results from his study of the peristalsis of the reversed loop, as only the circular muscle fibres contracted. He thought that Kirstein's conclusions were incorrect, that the bowel contents were squirted through the reversed loop which was passive. He made this more than bold criticism despite the fact that in Kirstein's case (No. 2) $\frac{1}{4}$ of the small gut was reversed. To imagine a force adequate to squirting food, etc., through $\frac{1}{4}$ of the length of the small bowel, requires more than an ordinary effort.

*W. Edmunds and C. A. Ballance*⁴—1896—repeated these reversal experiments, and though their work throws no light on the question of anti-peristalsis, they call attention to the fact that the reversed loop became shorter in their cases.

*G. Kelling*⁵—1900—published one reversal operation in the uppermost jejunum. Three and one-third months after this operation he opened the animal's abdomen, and made a more or less satisfactory study of the peristalsis of the reversed loop. He incised the lower end of the loop, and saw the contents moved towards the rectum by distinct peristaltic waves! This animal was alive and well $1\frac{1}{3}$ years after the operation.

*Muehsam*⁶—1900—contributed a great deal to this subject by bringing further evidence based on the second method of studying this problem—evidence along the same lines as Kirstein's, but perhaps more conclusive. He reversed practically all the small gut (430 cm. out of 485 cm.), and the animal lived 22 days, having occasional attacks of vomiting, and regular defecations. In the defecations, he recovered charcoal which had been fed by mouth 18 hours earlier. This unique case can in our opinion, be explained in only one way, by a reversal of the peristalsis in the reversed intestine.

³ Centralblatt f. Physiologie, p. 222, 1893.

⁴ Medico-Chirurgical Transactions, London, vol. 76, 1896.

⁵ Langenbeck's Archiv., p. 326, Bd. 62, 1900.

⁶ Mittheilungen aus d. Grenzgebieten d. Medizin u. Chirurgie, vol. 6, 1900.

(*Prutz and Ellinger* try to explain the phenomena here observed as the result of the action of the surface currents originally described by Grützner, to which reference has been made above.)

In 1901 *Enderlen and Hcss*⁷ experimented along these lines, and in one case made a study of the peristalsis in the reversed loop. By faradic stimulation, a peristaltic wave was produced in the reversed direction from normal, *i.e.*, the peristaltic wave was reversed in the reversed loop.

In 1902, *Prutz and Ellinger*⁸ reviewed the whole subject, and did further experimental work along the same lines. In one case they observed the peristalsis in the reversed loop, 31 days after the operation, and found that it was not reversed. They admit, however, that occasionally anti-peristaltic (reversed) waves were seen in the reversed, and in the non-reversed bowel. In all their 12 experiments this is the only observation or study of the peristalsis of the reversed loop. They, however, attempted to determine by other means, in which direction the peristaltic wave progressed. By producing a stenosis in the lower part of the reversed loop, and noting on which side of this, dilatation developed, they thought they could discover the direction of the wave. Thus if the peristalsis were reversed, dilatation would occur above the stenosis; if not reversed, dilatation would develop below the artificial stenosis. In 2 cases they obtained results which they interpret as showing no reversal of the peristaltic wave. In our opinion, they have gone beyond the data which they have published, and to us it seems as if their conclusion was not only unwarranted, but in view of the fact that the dilatation above the artificial stenoses was regularly much greater than that below, a conclusion, the direct opposite of theirs, seems justifiable.

This brief review shows how at variance the different results are. Most of the experimentors failed to study the peristalsis in the reversed loop. Some attempted such a study, but invariably only in one case. This most conclusive method of

⁷ Deutsche Zeitschrift f. Chirurgie, p. 240, 1901.

⁸ Langenbeck's Archiv., p. 964 Bd. 67, 1902.

deciding the problem before us has been signally neglected. The second method of investigating this question, Kirstein and Muehsam used successfully by making very extensive reversals.

In our work done on dogs, some 20 experiments in all, we employed both methods of investigation, and our results will be grouped according to the method employed. We operated in the usual way, cutting out a segment of small gut or large gut and then reversing it. The anastomoses were either end to end, or lateral. The latter was preferable when very large segments were reversed, as there was apparently, less direct tension on the suture line by opposed peristaltic waves, and consequently less chance of leakage. No matter how carefully the operation was done, leakage and separation at the upper anastomosis would occasionally develop so that we were inclined to conclude that the bowels of different dogs varied in their irritability, and perhaps in their muscular strength to such a degree that the technique that was adequate for one might prove inadequate for another, when the opposing and perhaps obstructive peristaltic waves caused undue pressure against the upper anastomosis. At the lower anastomosis, such leakage was most exceptional despite the fact that the direction of the peristaltic waves was probably in opposite directions, *i.e.*, tugging at the anastomosis.

In all animals that survived the operation, we did not make studies in peristalsis, as we were interested in other problems connected with this work, and did not wish to sacrifice all to this study. In the following pages we trust, however, we have sufficient data to warrant the standpoint we have taken.

SERIES I.—Direct Inspection of Reversed Loop—Small Intestine Reversals.

No. 84.—Spaniel operated March 15, '06. Median abdominal incision. Reversal of about 15 inches of lower ileum and lateral anastomoses in reversed position, to the bowel above and below lines of section.

March 20. After primary indisposition animal recuperated on diet of milk and biscuits.

May 20. Defecates regularly (practically daily; careful note of this being made every day). Animal began to do poorly.

June 9. Eleven weeks after the reversal a study of the peristalsis was made under ether, the intestines being well protected by very frequent use of warm saline solution, hot towels, etc. The peristaltic waves were stimulated in a variety of ways, mechanical, chemical and thermal stimuli being employed in the different experiments.

Observation.—The peristaltic wave in the reversed loop was very clearly in the same direction as that of the rest of the small bowel. Peristaltic waves that began above upper anastomosis traveled into the reversed loop and then down this across the lower anastomosis. Peristaltic waves which began in the reversed loop traveled to a slight extent upward, but in the main they traveled downward and then frequently across the lower anastomosis.

Autopsy showed in addition to some adhesions which produced slight kinking of the bowel, well marked dilatation and some hypertrophy of the lower end of the gut above the upper lateral anastomosis. The reversed piece was very slightly dilated and contained two large fecal masses.

No. 41.—Fox terrier had been frequently operated, *i.e.*, gastroenterostomy, gastrotomy before reversal was done.

March 8. After breaking up a lot of adhesions 24 inches of lower ileum were reversed and united to the rest of the bowel by end to end anastomoses.

April 1. Animal except for occasional vomiting did fairly well. By adding milk to his biscuit diet his condition was improved. Defecates regularly.

April 24. Six weeks and five days after the reversal the abdomen was opened to study the peristalsis as in the previous case. The exposure was difficult because of adhesions.

Observation.—The bowel proximal to the upper end to end anastomosis was found markedly dilated and hypertrophied for 6-8 inches. The upper part of the reversed gut for 1-2 inches was similarly changed. The rest of the reversed bowel—the lower anastomosis and the bowel below were unchanged. The reversed loop was empty, whereas the parts adjacent to the upper anastomosis were full of intestinal contents. In studying the peristaltic waves great difficulty was met with in determining which way they progressed. Above the upper anastomosis the wave was katastatic, *i.e.*, in the normal direction, while in the reversed loop mechanical stimulation as well as heat evoked once a peristalsis in one direction and at another time in the opposite direction. In the lower part of the reversed loop the direction of the peristaltic wave was more distinctly downward. Abdomen closed.

May 12. Nine weeks and two days after reversal, abdomen again opened for peristaltic study.

Observation.—After separating adhesions in abdomen, we attempted to stimulate peristalsis without any further manipulation of the bowel. Croton oil was injected into the lumen without results; local application of salt produced only localized circular contractions. Hot saline solution produced well-marked peristaltic waves, which could be seen beginning above the upper anastomosis, traveling across this anastomosis and con-

tinuing down the reversed gut. In this loop the circular muscle contractions were well marked. The progression of the peristaltic waves were distinctly from upper to lower anastomosis. The bowel was almost empty. Animal killed.

No. 90. Pug. On March 22d between 12 and 15 inches of lower ileum were reversed and end to end anastomoses (Maunsell method) were made. The dog was carefully fed on milk, meat and biscuits so that he might continue in good health for a long time.

October 23. Seven months after the reversal the abdomen was opened.

Observation.—There was marked dilatation above upper union for at least 15 inches. This piece of bowel was also hypertrophied. In the region of the upper anastomosis there was an accumulation of stones. The reversed loop was slightly dilated and markedly hypertrophied. The peristaltic waves were distinctly downward in the reversed loop.

SERIES II.—*Colon Reversals.*

No. 76.—On March 10, 1906, as much of the ascending colon as could be liberated—about 6 inches—was resected and reversed and then reunited by end to end anastomoses to the rest of the bowel. This case did well on the selected diet.

January 4, 1907. Almost ten months after operation the abdomen was opened and a study of the peristalsis was made.

Observation.—The reversed loop was dilated and hypertrophied. The peristaltic waves descend from the ileum across the upper anastomosis and then descend through the reversed loop, but stop at the lower anastomosis. Circular contractions follow each other in the reversed loop, in the same direction as the composite peristaltic wave. The reversed bowel contains foreign bodies.

These observations of the behaviour of the reversed loops leave no doubt in our minds that the small and the large bowels are capable of propelling food in an anti-peristaltic direction. It would appear that the bowel has a distinct power to work in an anti-peristaltic direction and moreover that this power is capable of extensive development. Early in the life of the reversed loop, there seem to be ana- and kata-staltic waves; later on the kata-staltic (which are anti-peristaltic with reference to the original normal bowel) seem to predominate. We are inclined to agree with Kirstein, that in the reversed loop, the peristaltic waves vary in direction, especially at an early stage in the life of the reversed loop, and that is well shown by Case 41, at the first study of peristalsis. Prütz and Ellinger's observation of anti-peristaltic alternating with isoperistaltic waves in their one case, seems to us to fit into this view

of the matter. Perhaps Mall's observation will bear a similar interpretation which harmonizes the divergent results summarized above. To what extent the reversed bowel moves kata-statically with abdomen closed, we can not say as yet.

Just why a more or less spindle-shaped dilatation develops at the upper union is not very clear to us. At first one would jump at the explanation usually offered—that there is an obstruction due to opposed peristaltic waves and that leads to dilatation and hypertrophy at this point.⁹

That some truth is contained in this explanation, in view of the fact that foreign bodies tend to collect in the lumen at this point, and in view of the observation made by Cannon and Murphy mentioned further on, we can not doubt, though we feel sure it is not the complete explanation, as the same obstruction would, we think, be manifested throughout the length of the reversed loop, still the loop as a whole does not dilate and hypertrophy.¹⁰

If we now turn our attention to the second or inferential method, *i.e.*, the reversal of very big segments of the bowel, we find that with reversal of the whole jejunum and ileum, most animals die of a perforative peritonitis due to leakage at the upper union. Those animals that live long enough to be of any value, behave much as Muehsam's case, defecating repeatedly after the first day or two, without any marked vomiting. These animals, probably because of the great change in the intestinal chemistry, digestion and absorption being rudely interfered with, die very suddenly. For instance, one animal thus operated on did well in every respect for five days and then died suddenly without any definite gross lesions to demonstrate the cause. Another died suddenly 10 days after operation, a few hours after receiving a good dose ($\frac{1}{2}$ ounce) of castor oil. This animal at autopsy had a fresh invagination at the lower anastomosis which occluded the bowel.

⁹ The fact that this dilatation develops very early lends support to this view.

¹⁰ The colon may behave differently from the small intestine—the whole loop apparently dilates and hypertrophies here.

But it is not necessary to rely on such extreme cases alone. It is sufficient to reverse some 15–24 inches, as we did in a large number of cases. For it is inconceivable that an animal can defecate regularly, if such a length of reversed bowel does not, at least from time to time, function kata-staltically. In the cases quoted above, such resections have been made and the animals lived in fairly good health and defecated practically every day, provided they were carefully fed. To cite further cases, from our lists, of prolonged life with regular bowel activity after such reversals would not be of any value. We regret that we could not duplicate Muehsam's case and keep an animal, with reversal of all the small intestine, alive for over three weeks.

Thus both groups of observations point to the conclusion that the intestines both large and small, are able to propel their contents in an anti-peristaltic direction.

Further evidence of the truth of this conclusion is furnished by the excellent observations of Cannon and Murphy,¹¹ who observed anti-peristalsis in the duodenum, a portion of the intestine that we could not experiment on. In a reversal experiment, where the jejunum was reversed close to the duodenum, they repeatedly saw, 6 days after operation, with the aid of the X-ray, that food left the pylorus and descended to the upper anastomosis and then was in part rapidly moved back again towards the pylorus. This unique observation makes it equally clear that there is a more or less marked obstructive condition at the upper anastomosis in these reversal experiments.

Cannon's earlier work on the peristalsis of the ascending colon of cats, shows without a doubt that Jacobi's¹² observation of anti-peristalsis in this part of the bowel (and in lower ileum in colchicin poisoning) was well founded. Here it would seem that this is a normal process,¹³ whereas our ex-

¹¹ ANNALS OF SURGERY, 1906.

¹² Archiv. f. Exp. Pathologie u. Pharmakologie, vol. xxvii, 1890.

¹³ Except in dogs. T. R. Elliott and E. Barclay Smith, Journal of Physiology, xxxi, 1904, p. 273.

periments do not take us that far, any more than those well known experiments of Nothnagel, in which he produced anti-peristalsis in the bowels by abnormal stimuli, such as injections of concentrated salt solution.

In addition to all this experimental evidence, we dare not disregard the clinical evidence which so frequently has to be taken with a grain of salt. In this paper we shall not go into this matter in any great detail, as our main object was to present our experimental results; still for completeness sake we must briefly mention the clinical evidence in favor of an affirmative answer to our postulated query, at the head of this paper.

Fecal vomiting in intestinal obstruction and the vomiting of fecal masses and enemata in so called hysterical patients, excluding of course actual cases of fraud can be most readily explained by this ability of the bowel, especially marked under abnormal stimuli of propelling their contents in an anastaltic or antiperistaltic direction.

These two types of fecal vomiting must be distinctly separated, as the former is explicable in several ways whereas the latter in our opinion is subject to but one explanation. In the vomiting of intestinal obstruction, the fluid contents of the bowel may be squeezed out of the bowel into the stomach, thence to the outer world by the pressure exerted by the forceful contractions of the abdominal muscles—anti-peristalsis may have nothing to do with it. Cannon and Murphy's observation, above referred to, makes us believe however, that anti-peristalsis is an important factor in this process, the more so as all of the bowel above an obstruction is not regularly well filled at autopsy of ileus cases, as the explanation based on hydrodynamics would demand. It appears to us, therefore, that both forces work together in producing this symptom.

The vomiting of formed feces and the vomiting of enemata a few minutes after introduction into a normal alimentary tract, as reported by Treves, Langmann¹⁴ and others,

¹⁴ A. Jacobi, Festschrift, 1900, N. Y.

cannot be explained by anything short of a most active anti-peristalsis of the whole bowel. In this we consider Nothnagel's verdict final, despite Wilms' recently expressed scepticism. The former says in his discussion of those cases, so called hysterical ileus cases, "that in no other way can this vomiting be effected than by well marked, in part even very active anti-peristalsis of the intestine."

RECTAL ANÆSTHESIA EXPERIMENTAL STUDIES TOGETHER WITH A REPORT OF ITS PRAC- TICAL EMPLOYMENT AT ROOSEVELT HOS- PITAL.

BY NOEL BLEECKER LEGGETT, M.D.,
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ETHERIZATION by rectum is by no means a new departure, for at different times in the past sixty years, methods have been sought whereby a patient might be anæsthetized by this method. Perigoff in his book on etherization published in 1847 mentions it. At the same time Roux in the *Journal de l'Academie des Sciences*, refers to the possible utility of rectal anæsthesia. Marc Duprey employed ether pure or mixed with water as an injection for the purpose of producing anæsthesia. Malliere in 1884 used ether vapor obtained by boiling ether and letting the expanding gas force itself into the rectum. In the same year, Hunter reported six favorable cases. He praised the method, but did not mention any after effects. Weir (*N. Y. Med. Rec.*, 1884, XXV, p. 507) gives seven cases reported by Dr. W. T. Bull, all of which had bloody stools following this method, besides two cases of his own, one of which ended disastrously.

Wanscher in the same year, 1884, records 22 cases of anæsthesia induced by injecting ether vapor into the rectum. All of his cases were favorable except one, in which he was unable to produce narcosis due to the presence of feces in the colon. But the next day after the colon was thoroughly cleaned out, the patient was readily anæsthetized. This shows the importance of having the lower bowel fully prepared before attempting narcosis (*Congress Med. Sciences*, 1884, p. 186, Sec. 1). Post reports three cases with no vomiting or diarrhœa (*Boston Med. & Surg. Jour.*, 1884, CX, p. 442). Bux-

ton used this method and advocated its use for operations on the head, neck and for empyema.¹

The method then lay idle from 1898 until two or three years ago when J. H. Cunningham of Boston again brought it before the public. He presented forty odd cases, all of which pointed to the practicability of rectal anæsthesia, if properly administered. Reading Dr. Cunningham's paper in the Boston Medical and Surgical Journal, it seemed, in view of his results with improved technic, that rectal anæsthesia had not had a full and fair trial in this city.

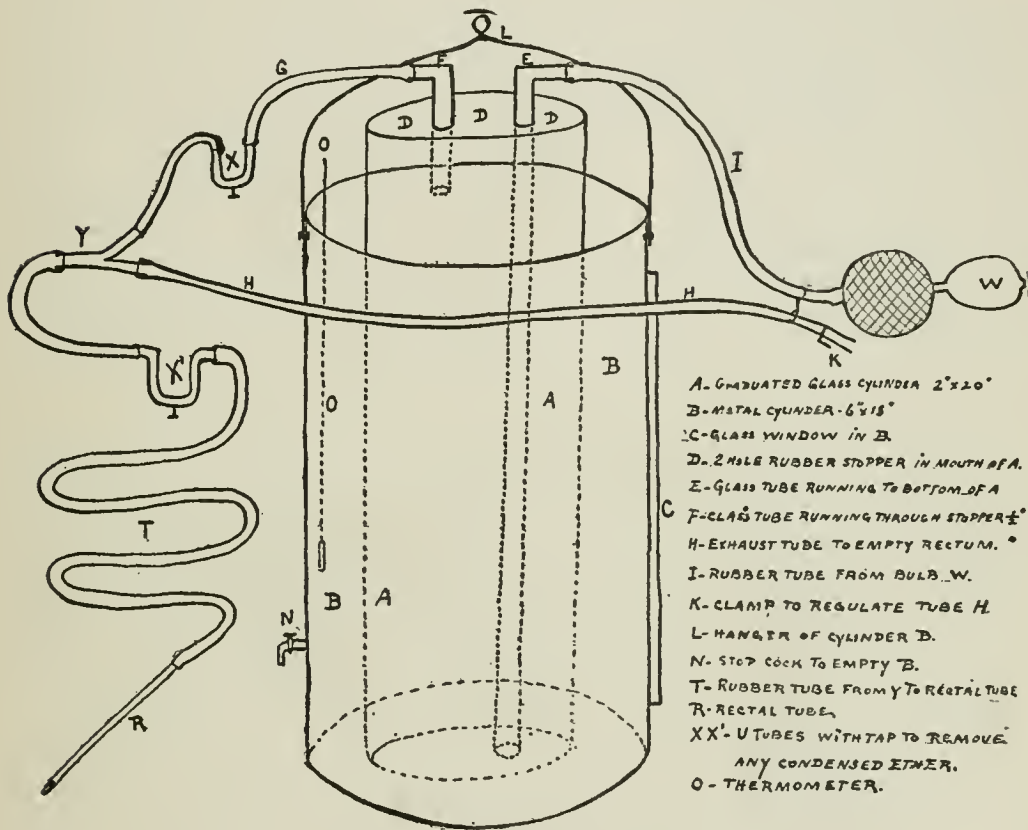
The method originally employed was that of boiling the ether in a vessel and allowing the expanding vapor to force itself into the rectum. In this way the vapor entered the rectum in such volume that there was a condensation in the tubes. Liquid ether was consequently forced into the gut, causing extreme irritation, ulceration and hemorrhagic proctitis.

Cunningham's method is somewhat similar, yet it varies in one vital point. The vapor of ether is forced into the rectum in such a way that there is no condensation, and absorption takes place with such rapidity that it is not possible for fluid ether to be forced into the gut. This is done by keeping the ether heated, yet constantly below 37° C. which is its boiling point, and forcing the fumes into the bowel by means of a rubber hand bulb. Herein lies the essential difference between the new technic and the old.

The apparatus is demonstrated in the accompanying cut. The effect upon the patient is as follows: He reclines in dorsal position with legs slightly flexed. The rectal tube is inserted 8 to 12 inches. Ether fumes are then slowly forced into the rectum. They cause a sensation of fullness so that the patient may have a desire to defecate. This is overcome by opening the exhaust tube at K and allowing the gases which are in the

¹ In 1898 S. J. Meltzer used ether by filling a bottle half full and placing it in a water-bath at a temperature above that of the rectum hot enough to boil the ether. He noted that ether is apparently more completely excreted when given by rectum than by the lungs.

rectum to escape. This should be repeated as often as may be necessary. It will immediately relieve any possible distress. The ether vapor is pumped in slowly, keeping the bowel comfortably full. The patient may have for a time slight discomfort, then becomes gradually drowsy and the odor of ether appears upon his breath. He falls asleep and in a comparatively short time has passed into full narcosis.



This method has its faults and its merits—its uses and its abuses. It will at once be conceded that if it can be made as free from danger as anæsthesia by mouth and free also from the danger of hemorrhagic proctitis, there are many operations about the head and neck in which its employment would be most useful. Studies directed toward determining what proportion of the ether administered is eliminated via the lungs are under consideration at the Laboratory. With the completion of these, it will be possible to state positively how

advantageous this method will be in cases of tuberculous pulmonary involvement.

Our post operative observations upon the patient may now be considered. The nausea, which in the inhalation method is still present despite many technical improvements is greatly decreased and in many cases absent after rectal anæsthesia.

So far I have given rectal anæsthesia in human beings in 13 cases only. We have, however, employed it upon dogs during a considerable period of experimentation. In these animals, it produces no proctitis, and if the fumes are allowed to pass the ileo-cecal valve, complete narcosis may be maintained for any length of time. Dogs have too short a colon to lend themselves favorably to this study. Through the kindness and interest of the attending staff of Roosevelt Hospital, I have had the privilege of using this method on the following cases:

CASE No. I.—It was one of cervical adenitis on Dr. Blake's service, operated upon by Dr. Martin; a boy, fourteen years old. Ether was started by the rectal method and in twelve minutes he became very heavy and drowsy, having had no discomfort whatsoever. After this, the patient muttered incoherently for a short time, then became quiet in 20 minutes after the ether was started and in 30 minutes there was absolute narcosis. The patient was under ether for 45 minutes during the operation, 85 minutes in all. The respirations were regular and full and there was none of the harsh rattling breathing due to bronchial secretions. The color was unusually good throughout the operation, and the blood was at all times well oxygenated. The patient made a rapid ether recovery, vomited once and had no rectal symptoms at all. Dr. Martin thought the blood did not coagulate as rapidly as usual.

CASE No. II.—Dr. Blake's service. Operated on by Dr. Martin—tubercular rib. This patient had tubercular conditions in other parts of the body. Had taken ether several times previously. Ether was started by rectum and in ten minutes the patient was drowsy, although he complained a good deal at the length of time consumed. In twenty minutes, he was completely

anesthetized. Breathing was regular, pulse good and strong showing the stimulus of the ether. Patient was under ether anæsthesia for thirty minutes in all. He made a quick recovery and had no rectal symptoms. He complained simply of the length of time taken in producing sleep. Said the method was free from pain.

CASE No. III.—Sacculated empyema. Operated upon by Dr. Blake. Anæsthesia was commenced both by inhalation and rectum, the patient being anesthetized in five minutes, then the ether continued by rectum during the operation, which lasted twenty minutes. The breathing was full and regular, color perfect and pulse all that could be desired. Rapid ether recovery with no rectal symptoms of any kind.

CASE No. IV.—Sarcoma of frontal sinus. Operated upon by Dr. Blake. Patient had had ether twice previous to this. Ether was started by mouth and rectum and in ten minutes the patient was completely anesthetized, when the inhalation was discontinued, but ether continued by rectum. The patient began to come out before reaching the table, so inhalations were again given till complete narcosis was again obtained, when it was discontinued. The patient again came out, and anesthesia by mouth was continued for the rest of the operation. This case was one in which the rectal method was not effectual. It demonstrated, however, with the preceding, that the ether vapor has no ill effect upon the mucous membrane of the colon, for the patient came through with no colic or other untoward symptoms.

CASE No. V.—Dr. Blake's service. Dr. Martin operating. Cervical adenitis. Rectal ether started and given for ten minutes when patient became drowsy. The operator being ready, ether was given by mouth till the patient was anesthetized, then anesthesia continued by rectum for one hour. The patient was in perfect condition throughout the whole of this time, made a good quick ether recovery with little vomiting and no rectal symptoms.

CASE No. VI.—Epulis. Dr. Martin operating on Dr. Blake's service. Ether began 12:15 by mouth and rectum. Patient under in five minutes when ether was continued by rectum for twenty-five minutes. Recovery with very little vomiting and no colon nor rectal symptoms.

CASE No. VII.—Hydrocephalus in a child three years old.

Operated upon by Dr. Brewer. Child was anæsthetized by mouth and rectum and then anæsthesia continued by rectum. Patient lost sensation in three minutes. The ether was continued for fifty minutes in all. At one time stimulants had to be given due to the shock of the operation as much as to any effect of the ether, if not wholly so. The child's ether recovery was rapid with some vomiting, but absolutely without any rectal irritation.

CASE No. VIII.—Axillary Carcinoma. Operated upon by Dr. Blake. Ether was started by mouth and rectum. The woman was fully anæsthetized in a few minutes. Patient defecated while going under. As soon as inhalation was stopped, patient began to come out of ether, and it had to be continued by mouth. The patient defecated several times, at last clogging rectal tube, so ether had to be stopped by rectum. Colon had not been adequately cleaned.

This case shows that it is most necessary to have the bowel fully cleaned before the patient can absorb the ether rapidly enough to keep up complete narcosis.

CASE No. IX.—Dr. Martin. Cervical Adenitis. Child—girl 5 years. Ether started by mouth and rectum. Patient anæsthetized in 3 minutes. Patient was under ether 30 minutes. The rectum being partially filled, it was difficult to regulate the anæsthesia. Patient defecated twice. Rapid recovery. Very little vomiting.

CASE No. X.—Dr. Blake. Cervical Adenitis—boy 16 years. Ether started by mouth and rectum. Patient anæsthetized fully in 5 minutes. Then ether continued per rectum. Patient under 30 minutes. No bronchial secretions. Patient at first was hard to control but in a short time was fully in a lax and narcosed condition. Patient made rapid ether recovery with no vomiting and no rectal distress.

CASE No. XI.—Dr. Brewer. Tubercular Laryngitis. Adult. 3.15 Morphine Sulphate, gr. $\frac{1}{4}$ given by hypo.

3.30 Ether by mouth and rectum. Ether continued by rectum 65 minutes; respiration, full, strong and regular; the pulse good.

Patient recovered from the ether rapidly with no rectal distress, and very little nausea or vomiting.

CASE No. XII.—Dr. Brewer. Carcinoma of Face. Ether

commenced by mouth and rectum and continued by rectum alone for 20 minutes. Rapid and easily recovery.

CASE No. XIII.—Dr. Flint. Epithelioma of Lower Maxilla. Resection of Maxilla. Ether started 2.15 P.M. Patient on the operating table 2.35, when ether was continued by rectum until 3.20. Color of patient good; pulse slightly rapid; no condition of shock. Rapid ether recovery with very greatly decreased nausea and vomiting.

These cases, though few show in a small way the possibilities which this method of etherization offers, both to patient and to operator.

Rectal anæsthesia may thus be summed up from two stand-points, viz., from that of the patient and from that of the operator.

The lessening of nausea, the lessening of irritation to the lungs and the lessening of the bronchial secretions which were nearly entirely absent in most of the cases are certainly all in themselves favorable. Furthermore, a fully and continuously clear field of action in all operations about the head and neck saving time and loss of blood and above all lessening the chance of infection from an ether cone, are all points in favor of the method which must appeal to every operating surgeon.

The chief points about the apparatus which we believe to be new and useful are, first the introduction of the Y and exhaust tube to empty rectum and second the glass U tubes which enable one to be certain that no liquid ether is passing into the rectum. It is a convenience and a safeguard for the anæsthetist to be able to empty the rectum of gas or of ether vapor at a moment's notice.

Since sending the above to the publisher I have had the good fortune to collect through the kindness of Dr. W. S. Sutton, of the Roosevelt staff, eighteen additional records of the use of rectal anæsthesia at the hospital. This makes a total of thirty-one (31) cases.

Two of these recent records deserve particular attention.

In the first case the patient was markedly alcoholic and therefore a large ether consumer. After ether recovery he had one small rectal hemorrhage. The cause of this is unknown. All succeeding movements were blood-free.

In the second case, Dr. Chas. H. Reck operated for the removal of an enlarged thyroid. He was struck by the advantages offered by rectal anæsthesia in this class of cases and believed that under favorable conditions it might in time supplant the slower method of cocaine infiltration.

A large number of suitable cases are now being anæsthetized by the rectal method at Roosevelt Hospital, and when Sutton's conclusions are published we shall know quite positively the advantages accruing from Cunningham's new technic.

TUBERCULINS AND THE TUBERCULO-OPSONIC INDEX.*

BY THEODORE DUNHAM, MD.,
OF NEW YORK.

THE present paper is in no sense a review of the work done and results achieved in this interesting field. My aim is to present the subject to you as it has presented itself to me. I shall be thoroughly practical and shall discuss chiefly the method of determining the tuberculo-opsonic index as I am practising it, and the tuberculins.

In the *Deutsche medizinische Wochenschrift* for April 1, 1897, Koch described his improved tuberculin. He told in what way the old tuberculin had disappointed, that repeated injections of it were followed by repeated improvements, but that these improvements had a limit, for an immunity was established against the tuberculin itself. This immunity may last several months. This immunity has no influence on the tubercle bacilli; it is, therefore, purely a toxin-immunity, not a bacterial one. The power to react was, unfortunately, often lost before a complete cure was established. A return of this power of reaction had to be awaited before the treatment could be continued. Where, however, sufficient patience and skill were exercised many cases might be cured, and he would still have felt that in the old tuberculin we had the best remedy for tuberculosis if it had not proved possible from tubercle cultures to make a pure bacterial-immunizing preparation. This, to be brief, he prepared as follows: The tubercle bacilli from young virulent cultures were desiccated in vacuo, ground to pieces in a mortar, taken up in distilled water and the mixture centrifugalized. There resulted an upper slightly opalescent fluid and a sticky sediment. The sediment was dried and put through the above process again. The resulting sediment

* Read before the New York Surgical Society, May 8, 1907.

was again treated in the same way, and so on until only incidental dirt remained as a sediment. The first supernatant nearly clear fluid he called Tuberculin O (oberste Schicht), or, for short, TO. This he found had properties very like those of the old tuberculin. The subsequent fluids resulting from the grinding and other manipulations of the successive sediments were mixed together and named Tuberculin R (Rests), or, for short, TR. It was so made that 1 c.c. contained 10 mg of solid substance. This solid consisted of pulverized tubercle bacilli minus certain elements which had been extracted and were contained in the TO. A peculiarity of TR which distinguished it from the old tuberculin and from TO was that its injection was to a far less degree followed by a temperature reaction. Koch regarded this as a distinct advantage possessed by TR over TO and old tuberculin. Koch began with injections of $\frac{1}{500}$ mg. of TR and gradually raised the dose to usually 20 mg. These figures refer to the solid substance in the TR. Secondary symptoms to cause anxiety, or any other encroachments on health which could be ascribed to the preparation, Koch said he saw in no case. Especially striking was the progressive straightening out and return to normal of the temperature curve. He said he did not venture to maintain that the method of beginning with minimal injections and gradually raising them to 20 mg. was the best way of using TR. He thought other methods of procedure, perhaps even combinations of TR with TO or with sera obtained with TO or TR might be found to be more effective. But further improvement in the matter of preparations made from tubercle cultures he did not think was to be looked for.

Another important communication from Koch appears in the same periodical under date of November 28, 1901. The subject of agglutination of the tubercle bacillus by sera of patients had come up. Koch made an exhaustive study of it. Before this there had been no means of measuring the degree of immunity attained. Koch came to the conclusion that the agglutination test gave this needed measure. In earlier immunizing attempts he had given to TR the preference over

TO because TR gave relatively weaker reactions than TO. But, guided by the agglutination test he now found it better to use the undivided culture mass, and, further, that the agglutinating power in man as well as in animals developed most surely and quickly when the reactions were not too feeble and when the doses were raised as rapidly as possible. He made a new tuberculin containing one part of pulverized tubercle bacilli in 100 parts each of water and glycerine. One c.c. thus represents 5 mg. He began with injections of 0.0025 mg. and rapidly increased the dose. He found that when agglutination had set in, or when that originally present had been increased, it was important to continue raising the dose; otherwise the agglutinating power would sink. He went as high as 20 mg. and in some cases 30 mg. That the development of agglutinating power is actually associated with the formation of protective substances he felt could be inferred, because from the moment that agglutination was established in his phthisis cases the condition of the patients was distinctly better. Some patients failed to develop agglutination, and in them of course the agglutination test could not be used to control the treatment. The preparation which Koch used for his injections is known as "New Tuberculin Koch (Bacilli Emulsion)." Both it and TR, which is now labelled "New Tuberculin Koch (TR)," are manufactured by the Farbwerke vorm. Meister Lucius and Brüning and are imported into this country by their agents, Victor Koechl and Co., 122 Hudson Street, New York.

Koch felt that the agglutination test gave him a measure of the degree of immunity which his tuberculin was producing. Wright believes he has discovered a better measure in the opsonic index. He infers from experiments that there are substances in the blood which act upon bacteria to make them easier victims for the phagocytic leukocytes. These substances he calls opsonins. There are apparently various opsonins for the various microorganisms. The proportion of opsonin in the blood Wright takes to be the measure, if not the reality, of the immunity. The relative amounts of opsonin in the blood of a healthy individual and in that of a patient are determined

by observing the phagocytic powers of leukocytes when in the presence of bacteria acted upon by the serum of the patient, and their phagocytic powers when the bacteria are acted upon by the serum of a healthy individual. The average number of bacteria found in a polynuclear leukocyte in the case of the patient's serum, divided by the average number found in the case of the healthy individual's serum, is the opsonic index of the patient. It is expressed in decimals for convenience of comparing various indices.

I have chiefly concerned myself with the tubercular index. In spite of reading the contributions of Wright, I have found this work difficult. Dr. Simon Flexner has saved me much preliminary stumbling by showing me the opsonic work which Dr. Edwin H. Shorer has been engaged in at the Rockefeller Institute. I am deeply indebted to Dr. Flexner and Dr. Shorer for introducing me to the practical details of opsonic technique.

As the communications of Wright are accessible to all, I shall not take your time to describe the mode of determining the tuberculo-opsonic index in all its many details, but shall confine myself to speaking of the snags which I have encountered and the ways in which I have put them aside. The three ingredients for determining the phagocytosis are the serum, the mixture containing the leukocytes, and the suspension of tubercle bacilli. There is no trouble about getting the serum. The only point about the leukocytes is to centrifugalize them at such a slow rate that they shall not be pressed together into coherent clusters, but shall remain discrete. I find that if the centrifuge runs at 900 revolutions for half an hour the result is perfect. There is more trouble about the suspension of tubercle bacilli. For making this I have used the coarse powder of agglomerated bacilli which is a by-product in the manufacture of tuberculin. The method of grinding this in a mortar results in a considerable fragmentation of bacilli, which adds somewhat to the difficulty of counting accurately, and the grinding is tedious. I have discarded the mortar and have made a shaking machine which I use instead. It contains a mill-wheel run by water from an ordinary faucet. To the wheel-shaft is

attached a crank, and to the crank a rod, the further end of which plays through a bearing about 14 inches distant. To this rod is attached a trough, into which the object to be shaken is snugly packed in cotton and firmly tied. The stroke is 2 inches and the crank makes about 400 revolutions a minute. I put some of the bacilli powder, some glass beads and the suspension fluid into a glass tube and seal the tube. I put this tube in the shaker, turn on the water and let the machine run six or eight hours. Individual bacilli become disengaged in abundance and there are few fragments. I then fill a tube for two inches with the opaque shaken mixture and centrifugalize it at about 3,000 revolutions for six minutes, after which the top half inch is aspirated off. This fluid may contain too many bacilli, in which case the proper dilution is made.

Another difficulty I have found in getting the smears well stained for counting purposes. There are three desiderata. The bacilli should be intensely stained, so as to be seen with the least effort. The nuclei should be lightly stained, so that bacilli overlying them are readily seen. The outlines of the leukocytes should be visible.

I have struggled much over this matter and have arrived at the following staining method: Fix 20 seconds in wood alcohol. Wash. Stain 5 to 10 minutes in a bath of carbol-fuchsin, standing in boiling water. (I have made the carbol-fuchsin of double strength, 20 parts sat. alc. sol. fuchsin to 80 parts 5 per cent. carbolic acid, and evaporated it down on a water bath until it was of sufficient strength to make a good reddening of the smear in 5 minutes.) Wash. Decolorize one minute in 5 per cent. H_2SO_4 . Wash. Counterstain 30 seconds in $\frac{1}{4}$ per cent. sat. alc. sol. methylene blue in $\frac{1}{2}$ per cent. sol. Na_2CO_3 . Wash lightly. Dry by agitation in the air. If the smears are good, the pictures are also good.

I wish I felt justified in saying something about results of treating cases of surgical tuberculosis under control of the opsonic index. I have encountered so many difficulties in the technique that my energies have thus far been mostly absorbed in trying to overcome these. In this field it is folly to make

clinical deductions until one is sure of getting indices of fairly uniform accuracy. As the sera of patients are supposed to vary widely without treatment and to fluctuate under the influence of treatment, the accuracy of the determination can best be gauged, it seems to me, by including in each batch of sera to be opsonized, the sera from more than one normal individual. These normal sera serve as opsonic standards in the same way that a pasted serum does, and in addition they serve as mutual controls upon the accuracy of the work. If the indices of the normal sera are not in accord, suspicion is cast upon the results in the whole series. I have adopted this method of control, using my own serum and those of my two sons. My results are as yet too few to warrant definite conclusions as to the accuracy of the technique or the value of the tubercular index, but my experience makes me feel that the results obtained by anyone who has not thus controlled his work until quite sure of his ground are to be received with scepticism.

Wright has used for his injections Koch's TR, and has generally begun with a dose of $1/1000$ mg. He has usually found that the index could be kept highest by using very small doses, rarely going higher than twice or three times this amount. In the matter of dosage he is thus at great variance with the conclusions reached by Koch when he controlled the dosage by the agglutination test. It would seem that if the opsonic index is the true criterion of dose and interval, then the agglutination test is not the true criterion. It is a question whether the Bacilli Emulsion is or is not better than TR in this treatment. The whole subject calls for much careful work with the closest coöperation between the clinic and the laboratory.

The brilliant results recorded by Wright and his colleagues compel enthusiastic attention to the subject, intricate and laborious though its demands are. Only through careful work by many impartial observers can its practical usefulness be shown. If others can achieve the results which Wright and his fellow-workers record we shall be able to treat effectively cases of surgical tuberculosis in which operative treatment and other surgical measures now leave so very much to be desired.

TUMOR OF THE CAUDA EQUINA REMOVED BY OPERATION: RECOVERY.

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TUMORS within the spinal canal are of sufficient rarity to justify the publication of the present case. It presented to the surgeon some points of interest and some difficulties in the matter of diagnosis and to the patient the not unimportant one of complete recovery.

Mrs. W., æt. 45, a widow. Personal and family history good. Complained of pain (sciatica, she called it) in both legs, lasting for at least four years. The pain began in the right leg about the middle of the back of the thigh, and "the painful area could at first be covered with the thumb." The pain was constant and of a gnawing character. She could not bear to sit squarely on a chair, owing to the pain, and had to sit on the edge so as to prevent the chair from pressing on the back of the thigh. Although the pain was constant it varied in intensity, was always worse after exertion, and frequently at night was so severe as to preclude all possibility of sleep. During the last two years the pain has become so severe as to almost completely incapacitate her from carrying on her ordinary household duties. During this time the only position of comparative comfort was lying curled up in bed. When she stood upright the pain rapidly became so severe that she was unable to remain erect, but on lying down again the pain would gradually diminish to its usual degree of intensity.

During these years the patient underwent various forms of treatment and consulted many medical men, her case being looked upon and diagnosed differently by each one who saw her. She was treated in a London hospital as a case of sciatica and had the sciatic nerves dry-stretched; she also underwent a course of electrical treatment, both galvanic and faradic, and, at a later date, in another hospital, a course of treatment with the high-

frequency currents. She was sounded for stone and had the cautery applied to the backs of the thighs. At a later date she was treated with rest and splints in a modified Weir-Mitchell treatment.

Although the pain began in the right leg, it was when I first saw the patient worse in the left leg.

Physical examination.—The first thing which struck one on looking at the patient was the wasting of the muscles of the buttocks and of the lower limbs. The gluteus maximus on both sides was wasted, soft, and flabby; so that the normal contour of the buttocks was lost. The hamstrings and ischial portion of the adductor magnus were wasted and flabby. The calf-muscles were so reduced in size that all appearance of calf was lost and the anterior tibial muscles were atrophied. The quadriceps extensors, though reduced in size, had not lost their contour and the adductors were not obviously affected.

The knees could not be straightened and the patient could not stand without support. There was no obvious wasting of the quadriceps extensor in either leg nor of the adductors. Although there was weakness of the wasted muscles, there was no paralysis. The knee-jerks were not altered; there was no clonus, and the plantar reflex was diminished.

The measurements of the two limbs showed that they were much smaller than would be expected in a person of that build, and the left was three-quarters of an inch less than the right all the way down. There were no tender points to be made out and the tactile and pain sensations were relatively diminished as compared with the front of the thighs, as also was the sensation of heat and cold. The skin showed no obvious change and there was no zone of hyperæsthesia either in the trunk or limbs.

There was pain on deep percussion over the lower lumbar region and pain was felt in the same place when the patient stood for a few minutes or bent forwards. There was no deformity of the spine and no evidence of sacro-iliac disease. The bowels were constipated and she did not pass water oftener than once in the twenty-four hours.

The salient points of the case were: 1. Pain in the back and along the course of the sciatic nerves. 2. Wasting of the glutei maximi muscles and all the muscles supplied by the great sciatic nerves. 3. Pain on deep percussion, on bending forward

and on standing in the erect position, the pain being felt in the lower lumbar region and radiating along the course of the sciatic nerves. The pain was constant and had been existant for at least four years, and the atrophy of muscles had been observed for at least two years.

Differential diagnosis.

Sciatica was negatived by both sides being affected and by the disease not being limited to the sciatic nerves; for the condition of the gluteus maximus clearly showed that the inferior gluteal nerve, at least, was involved and sciatica could not account for the pain in the back.

Neuritis was negatived by the extent of the lesion, its duration, the absence of paralysis and the causes which produce that disease.

Pressure on nerves from disease of the sacro-iliac joints was negatived by the extent of the lesions, its bilateral condition. It was impossible to conceive disease of both joints about the same age producing pressure in almost exactly the same place and to almost exactly the same degree; besides, there was no evidence of disease of the sacro-iliac joints or any other disease in the pelvis.

Finally we are brought down to the spinal canal. Pressure in the spinal canal could produce all the symptoms, and that, too, with a comparatively small lesion. If we look at the condition of the patient for a moment it will be obvious that the lesion from which she suffered was one that involved the fifth lumbar nerve and all the nerves below that level on both sides of the body. That the fifth lumbar nerve was involved was proved by the condition of the gluteus maximus, which it will be remembered is supplied by the inferior gluteal nerve derived from the fifth lumbar and first and second sacral nerves, and that all the nerves below that point were involved was proved by all the muscles supplied by the great sciatic nerve being wasted and by the retention of urine.

Pain was the first symptom and was constant throughout the disease; later wasting and muscular weakness supervened. A lesion in the spinal canal would account for all the symptoms, and such a lesion might be due to: a. Disease of the spine-caries, or b. Tumor in the canal.

The lesion in this case, because of the symptoms and progress, must obviously be situated on the posterior aspect of the

canal; so as to produce pain first and weakness and wasting later. And as caries of the spine practically always attacks the bodies and not the laminæ, and as there was no evidence of disease of the spine, the spine was excluded. The question of an exostosis on a lamina was put out of account because it seemed impossible that pressure by a hard rigid body could have existed so long and not have produced paralysis. The lesion, it was felt, must be soft because of the absence of paralysis.

Finally the question to decide was, is this a lesion of the cord or of the cauda equina?

A tumor, pressing on the posterior aspect of the spinal cord, must have destroyed the posterior region of the cord before it could have produced weakness and wasting. Moreover the tumor must have been a long one to catch all the roots from the fifth lumbar downwards and this would have meant the abolition of the reflexes and loss of sensation. If, on the other hand, the tumor had not extended over the whole region of these roots, but had been situated over the fifth lumbar segment, then the reflexes below that segment would have been increased by the lower centres being cut off from those above. For these reasons the cord was excluded and finally we come to the cauda equina.

Pressure at the level of the fifth lumbar vertebra would catch the fifth lumbar roots and all the roots below that point. It would catch the posterior roots first and then through them the anterior roots.

Finally we arrive at the diagnosis that the patient is suffering from a tumor in the spinal canal at the level of the fifth lumbar vertebra, that it is soft and probably non-malignant.

Operation January 12, 1907. The spinal canal was opened in the usual manner and the dura mater exposed, and a zone of thickened and congested dura brought to view at the level of the upper border of the fifth lumbar vertebra. On opening the theca an encapsulated tumor was found extending along the body of the fifth lumbar vertebra and into the upper part of the sacral canal for the matter of half an inch. The growth was easily shelled out without injury to the nerve roots. These were all found to be pressed forward against the vertebral body except one, which was pressed against the postero-lateral wall of the subdural space on the left side. After removal of the tumor the edges of the theca were drawn together with a continuous suture

and the rest of the wound closed in the usual manner, deep sutures being used to approximate the muscles and close in the space. The wound healed by first intention and the after-treatment presented no special features of interest. A catheter was passed three times daily after the operation for the first ten days, so as to avoid any possibility of the dressings becoming soiled and the wound thereby infected. After that time it is interesting to note that the patient voided urine naturally and the usual number of times in the twenty-four hours; in fact, that the retention which she had had so long ceased.

For some weeks the patient complained of pain in the old positions, but notwithstanding this she slept well and her limbs began to grow. Seen May 25, 1907, she expressed herself as quite well; she is able to walk two miles without a rest; attends to her ordinary household duties and her garden, in which she is much interested. She has gained considerably in weight, and the limbs have grown till they present quite normal proportions. The actual measurements of the two limbs before and after the operation are as stated below:

BEFORE OPERATION		
	Right	Left
Thigh.....	16 $\frac{7}{8}$ "	16 $\frac{3}{8}$ "
Calf	12 $\frac{3}{4}$ "	11 $\frac{7}{8}$ "

AFTER OPERATION, May 25th, 1907		
	Right	Left
Thigh.....	21 $\frac{1}{4}$ "	21 $\frac{1}{4}$ "
Calf	14 $\frac{3}{8}$ "	13 $\frac{3}{4}$ "

The pathological report stated that the tumor was fibromuscular, with large vessels, but no trace of malignancy.

MULTIPLE EXOSTOSES, INCLUDING AN EXOSTOSIS WITHIN THE SPINAL CANAL WITH SURGICAL AND NEUROLOGICAL OBSERVATIONS.

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AND

THOR. ROTHSTEIN, M.D.,

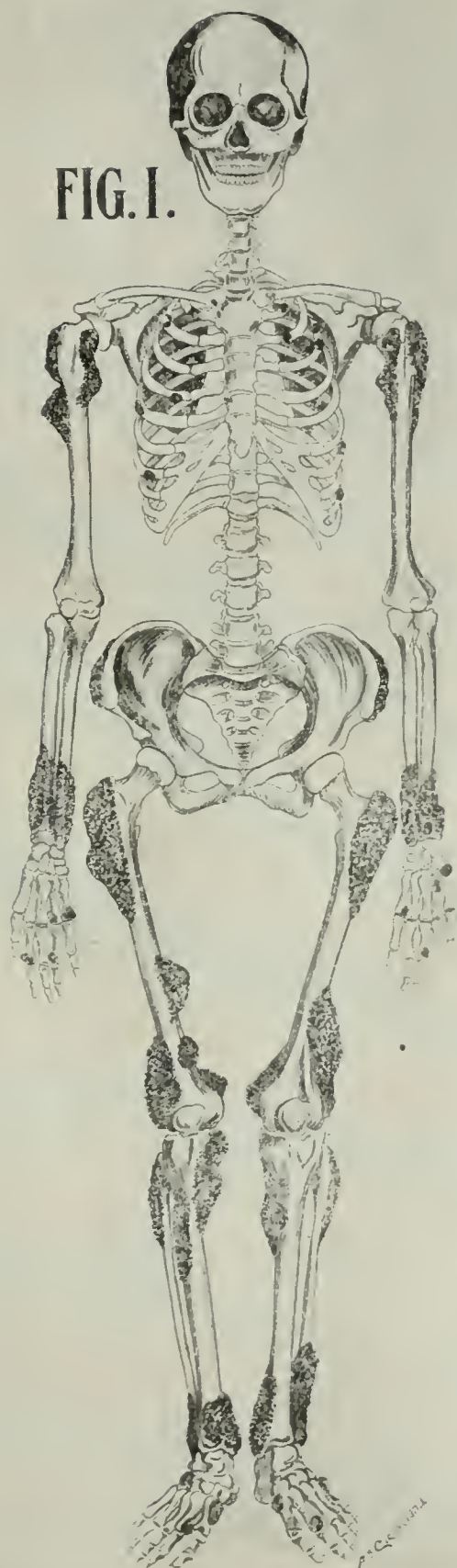
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EXOSTOSES of the human skeleton occur as chondroma, osteochondroma, and osteoma. They are not very common and fortunately those cases in which the exostoses cause marked disturbances are very rare. In the following case one of the exostoses caused serious trouble.

The patient, male, age twenty-three, was admitted to the Augustana Hospital October 8, 1906. No history of similar trouble among any of his relatives for several generations back. Father died at the age of forty with meningitis, probably tubercular, after an illness of several weeks. His father's left hand had been injured in a saw-mill several years before his death, causing ankylosis of all of the fingers of the left hand, the index and middle finger being held straight, the ring and little finger slightly flexed. There were also numerous bony irregularities on these fingers. During his last illness, while the mother was several months pregnant with the patient, the mother repeatedly stroked this irregular hand. Patient and patient's mother ascribe his exostoses to this prenatal influence, more especially as the patient habitually held his left hand in this same position during the first few years of his life, though the joints were never ankylosed. Except for these multiple exostoses patient has always been well.

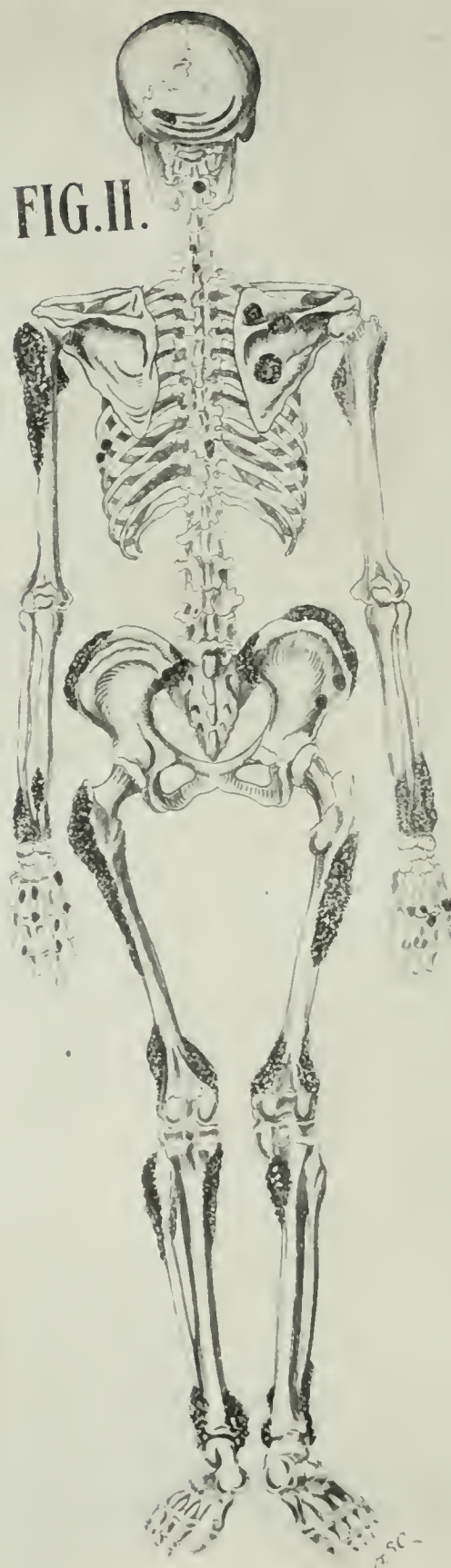
At the age of fourteen first occasionally noticed slight incoördination of the lower extremities. When trying to move quickly and especially if tired, lower extremities would tremble

FIG. I.



Anterior view of skeleton with multiple exostoses.

FIG. II.



Posterior view of skeleton with multiple exostoses.

and he could not place the feet exactly where he wished them to go. This became appreciably worse, especially in the right leg, and later appeared in the right arm. Since February, 1906, his right leg has dragged more than usual, his right hip seemed more stiff, and he had greater difficulty in walking. Since August, 1906, he has noticed that he has had less accurate control of his right arm and hand and that the tactile sense of his left arm and hand was somewhat impaired. From this time on the condition grew progressively worse, though there were intervals of slight remission, lasting sometimes for only a few hours at a time, so that by November 27, 1906, the patient was unable to walk at all even with crutches.

March, 1906, while pitching hay and straining considerably he had a feeling as of wrenching his neck, which caused pain on the right side of the body lasting about two hours. One month later he suddenly turned his head to the right and had a similar pain, plus a pricking sensation in the back and right side of body. After this every time he turned his head suddenly to the right this same pain would recur. Turning to the left caused no trouble. Since May, 1906, he never turned his head to the right; instead, when wishing to turn to the right, he would rotate the whole body. June, 1906, patient injured right knee, causing as he thinks a laceration of the ligaments.

On careful examination we found one-hundred-and-eight exostoses, as represented in Figs. 1 and 2. It is to be observed that there is one on the left superior curved line of the occipital bone. This is very unusual. In a rather careful study of the literature we were unable to find any reported case of an exostosis springing from the external surface of the bones of the roof of the cranium. It is supposed that the bones of the roof of the cranium are developed in membrane, hence are epiblastic in origin, while nearly all the remaining skeletal bones are developed from cartilage and are mesoblastic in origin. It has occurred to me that possibly there is this developmental reason for the fact that exostoses do not as a rule spring from the roof of the cranium, while they are found attached to practically any one of the other bones and it may be that in this case the tabular portion of the occipital bone

developed from cartilage instead of developing in membrane and that this might account for the exostosis which we find here springing from the superior curved line of the occipital bone.

A very common location for exostoses is the ventral surface of the scapulæ, and in this case too we find a large exostosis on the ventral surface of the right scapula. The epiphyseal lines of the long bones and the insertion of tendons are also favorite seats for their development and in these two points our case conforms to the general rule. Their location and attachment to the various bones, as well as the density of the tumors is very clearly brought out by the skiagrams kindly furnished me by Dr. Reichmann, as represented by Figs. 3 & 4.

The question as to the age of development of these exostoses is still unsettled. In this patient the exostoses were first noticed at the age of two, and the patient thinks they continued to grow at about the same rate as the body and stopped growing with the body at the age of nineteen. This also is very doubtful, however, because it was not until after he was nineteen that the cord symptoms became at all pronounced, and my assistant, Dr. Abelman, who has observed this patient very carefully for the last four months is of the opinion that several of the exostoses, especially the one under the right scapula, have increased in size since the first examination. By some writers it is also claimed that these exostoses will occasionally spontaneously disappear in later life. In this case we have no evidence that any have either decreased or have disappeared.

With the above history the question naturally arose as to how much of the disability was due to the rather severe injury to the right knee which the patient had sustained in June, 1906; whether or not there was some central nerve lesion, and if a central nerve lesion, was it an undiscovered exostosis making pressure upon the central nervous system, or was it a disease of the central nervous system itself. For solution of this question the patient was referred to the neurologist, Dr. Rothstein, whose findings of the nervous symptoms follow below, and who was

FIG. 3.



Skiaogram of bones at shoulders affected by exostoses.

FIG. 4.



Skiagram showing femora.

able to make a rather definite diagnosis as to the location of the trouble. He referred the disturbance to the right half of the cord between the base of the skull and the upper border of the fifth cervical vertebra, probably opposite the second.

The patient was consequently anæsthetized and the incision made in the median line extending from the external occipital protuberance to the sixth cervical vertebra, muscles and fascia separated from the vertebra, spinous processes and laminæ of the second and third cervical vertebræ removed with bone forceps and attached by a small pedicle to the anterior surface of the right half of the second cervical vertebra. The tumor, represented by Fig. 5, was found within the dura pressing upon the cord and flattening it out considerably. The tumor proper was attached by the small pedicle to the lamina of the vertebra, the pedicle passing through a small hole of the dura, the tumor itself lying within the dura directly on the cord. When the tumor had been removed the cord appeared normal and bulged out. Fig. 5 represents the condition found as accurately as could be determined. The left lamina seemed to be more vertical than normal and shorter, while the right was longer than normal; the spinous process was consequently deflected a little to the left of the median line. Fig. 6 shows an average second cervical vertebra of normal size, while Fig. 5 represents a drawing based upon the normal in size, but modified in shape according to the conditions observed with the tumor drawn in its actual size.

It seems almost incredible that the cord could have sustained so much pressure for so long a time and not have suffered more. The dura had to be incised in order to get the tumor out, and no attempt was made to suture it. A small gutta percha drain was introduced down to the cord, the wound closed, and a large antiseptic dressing applied.

All of the operating on the vertebræ was done with the greatest care, and the tumor removed as gently as possible, and yet, on regaining consciousness, the patient complained of numbness of the whole body and was unable to move any of his extremities, anal sphincters were completely relaxed, the bladder was paralyzed. Five hours after leaving operating table slight motion in left arm and leg, but none in right; sphincters still relaxed, bladder still paralyzed. Eighteen hours after leaving operating table complete loss of sensation of left upper extremity,

impairment of sensation in remaining extremities, motion of left arm and leg fair, except that left arm was ataxic, muscle sense being completely lost, right arm and leg, right half of diaphragm and right intercostal muscles completely paralyzed. About two weeks after operation, motion began to return on the right half of the body, and since this time sensation and motion have slowly but gradually improved, and now three months after the operation he is greatly improved. He is now able to move his neck in every direction without the slightest pain and he is able to walk very comfortably with crutches, though he still suffers considerably from ataxia. His exact status is also given below by Dr. Rothstein.

It is only occasionally that operative intervention is required in cases suffering from multiple exostoses, because fortunately these tumors are usually located where they do not cause any great harm or inconvenience. Some of the indications for operation are excessive weight of the tumors, or their location in places where they cause pressure sores, interference in the mobility of joints, pressure upon nerve trunks with their resultant neuralgias and pressure upon important organs as in the case above given in detail.

Some years ago I saw a case in which it was necessary to remove an exostosis from the upper end of the radius because it caused interference with the rotary motion of the forearm. Recently I have had to remove a multiple exostosis of the lower end of the radius for the same reason. These three cases are the only cases of exostosis that I have ever seen where operative interference seemed indicated.

NEUROLOGICAL OBSERVATIONS.

When I first saw the patient he presented the picture of a spastic paresis, more marked on the right than on the left side. He was able to walk but little on account of the stiffness in his legs. After a few steps his legs, especially the right one, would come into a state of trembling, making it impossible for him to walk. The trembling once started would persist for some time, but would gradually subside during rest. Active movements

FIG. 5.



Exostoses springing from one of the lamina of axis and growing into the spinal canal.

FIG. 6.



Normal axis, to compare with diseased axis shown in fig. 5.

would cause trembling also in the arms, intense in the right arm, slight in the left. His right arm was contracted, being held in adduction and flexed to right angle in the elbow joint, and the hand was halfway closed. He was able to execute actively only very slight movements in the shoulder joint, and in the elbow joint flexion and extension of about ten degrees. The fingers could only be slightly extended and flexed, the hand being completely useless. With the right leg he could execute active movements more freely, but all the movements were weak and much limited in comparison to the normal.

Passive movements in any joint of upper or lower right extremity would meet with intense resistance. The left arm and left leg were weak, but could be freely moved actively. Passive movements would meet with some resistance.

The tendon reflexes of all four extremities were increased. Wrist and patellar clonus existing on right side, foot clonus on both sides, a strong Babinsky reflex on right and a slight but distinct Babinsky reflex on the left side.

The cutaneous reflexes were lively.

The only disturbances of the sensibility possible to demonstrate were a slight ataxia in left arm and leg and inability to recognize objects with his left hand when his eyes were closed.

His tongue was slightly asymmetrical, the left half being somewhat smaller than the right, and when the tongue was protruded it would sometimes deviate to the left.

The fundi of the eyes were normal, but a distinct nystagmus could be observed when the eyes were moved to the extreme left or right.

He had perfect control of the sphincters.

The above described symptoms might suggest the diagnosis of a disseminated sclerosis, or some other kind of sclerotic process in the central nervous system.

The patient presented, however, a symptom which directly pointed to the existence of an exostosis in the spinal canal. As Dr. Ochsner already has mentioned, the patient sometimes felt a sharp pain shooting through his whole body when he turned his head to the right. This pain occurred only when he turned his head suddenly to the extreme right. Sometimes it happened that at the same time as the pain was felt in his whole right side from the neck down to the toe, he also felt a pain shooting upward in

the back of his head on the right side. When he, immediately after such an intentionally produced pain, outlined the course of the pain in the back of the head, it was found that the pain followed the course of *nervus occipitalis minor* on the right side. As *nervus occipitalis minor* gets its fibres from the second and third cervical root (that is, the nerves which leave the spinal canal, the one immediately above and the other immediately below the second cervical vertebra), the mentioned symptom pointed towards the second cervical vertebra as being the seat of the tumor. By examination of the shoulder muscles it was found that the *musculi rhomboidei* and *musculi levator anguli scapulæ* on the right side were much weaker than the corresponding muscles on the left side, and percussion of the *trigonum scapulæ* would cause much more lively contractions in *rhomboidei* and *levator anguli scapulæ* on the right side than on the left. As the new fibres which supply *musculi levator scapulæ* do not leave the spinal cord lower down than the fifth segments (corresponding to the level of fourth cervical vertebra), it was clear that if the spastic process was due to anosteomia this must sit on the fourth cervical vertebra or higher up.

On account of the mentioned pain along the *nervus occipitalis minor* it was, however, considered that the supposed tumor most likely would be found on the second cervical vertebra. The motor symptoms being so much more pronounced on the right side, it was necessary to assume that the tumor pressed upon the right side of the cord, but there one would expect some of the symptoms usually present in a half-sided lesion of the cord. A slight suggestion of such a lesion gave the ataxia of the left extremities and the sensory disturbances of the left hand. The nystagmus and asymmetry of the tongue might be explained either as congenital or as symptoms of intrinsic affection of central nervous system.

A week after the operation the patient presented a typical picture of half-sided lesion of the cord, with loss of all the different qualities of sensation, including muscle-sense, on the left side, with hyperæsthesia and flaccid motor paralysis on the right side. He gradually improved, and three months after the operation his condition was the following: Active motility of left upper and lower extremity normal; no stiffness on passive movements. Right arm can be adducted from the body and lifted up to 135° .

and rotation is nearly normal. Full flexion and extension are possible in the elbow joint, but by extreme extension motion becomes a little slow.

Pronation and supination are of less than normal degree. Flexion and extension of right wrist joint 40° . The thumb can only be slightly extended and flexed. The right index finger can be fully extended and flexed, but the other three fingers cannot be extended fully, especially not the little finger. He can spread and adduct the fingers to some degree. The grip of the right hand is weak, but has increased considerably in strength. By passive movements some resistance is felt, but the stiffness is easily overcome.

The passive and active movements in the ankle and toes are nearly normal, some resistance existing in the ankle joint by passive movements. The movements of left knee and hip joint could not be examined on account of a plaster cast having been put on the leg.

The patella-reflex on left side somewhat decreased. On left side no ankle clonus is present and only a slight amount on right side. A slight Babinsky reflex can be elicited on left and also on right side.

The tendon reflexes of right arm seem about normal. The abdominal reflexes are more lively on left than on right side.

Sensation for touch-, temperature-, pain-, and muscle-sense were normal on right side. On the left side a slight stroke with cotton would not be felt over dorsal aspect of the two extreme phalanges of all the fingers, neither would it be felt over dorsal aspect of foot and toe. If the pressure of the cotton was made a little heavier, the touch would, however, be felt. The patient stated himself that although he felt the slight touches of cotton over the rest of the left side he did not feel the touch nearly as clearly on the left as on the right side.

Sensation for pain was decidedly decreased over the whole left side, with exception of the area supplied by nervous trigeminus.

All passive movements in any joint on left side he would perceive and judge nearly correctly, but by active movements a marked ataxia was apparent in the hand. An object, knife, coin, etc., put in his left hand (when his eyes were closed) would not be identified and invariably dropped.

Sensation for temperature was decidedly diminished on the left side.

The nystagmus seems to be less marked than before the operation.

The patient returned to the hospital and was examined again May 30, 1907.

He is considerably improved. He is able to use his right hand to some extent, to dress himself and button his clothes, which was impossible for him in the month of March. He walks now without crutches, but his right arm is carried somewhat stiffly, usually flexed in the elbow joint. The right leg is still in a cast. The right arm can now be stretched straight upward, and can be fully extended and flexed in the elbow joint, although the last part of the extension is still a little slow.

Flexion and extension in wrist joint to 45° and 50° . Fingers can be fully extended and flexed except thumb and little finger. Grip of right hand has gained considerable in strength, but is still much weaker than grip of the left hand.

Passive movements in all joints of right extremities meet with some resistance, especially if the movements are done suddenly.

Marked Babinsky reflex. Foot and patellar clonus exist on right side.

The tendon reflexes of right arm increased.

On the left side stroking of the foot sole causes flexion of the big toe and the patellar reflex is lively. Abdominal and cremaster reflex much livelier on left than right side. Feels slight stroke of cotton over whole left side, but sensation a little uncertain over dorsal aspect of the foot and toes. Sensation for pain has improved, but needle is still felt less sharp on left than on right side. His ataxia is also considerably less than in the month of March. Objects put in his left hand are usually not recognized, but they are felt and not dropped.

The reflexes which after the operation became decreased have later gradually increased, such as the left patellar reflex, the foot clonus on the right and the tendon reflexes of the right arm. But the Babinsky reflex on left foot disappeared, and the sensibility and mobility have in the same time improved.

The nystagmus is markedly less than before the operation.

TUBERCULOSIS OF THE ELBOW, ARTHROPLASTY.

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THE following is a brief account of a successful attempt to reëstablish a hinge joint at the elbow, after resection of the joint for tuberculosis. The result is the more interesting since the case has been followed for three years after operation:

History, R. P., 18 yrs.—She was first seen at the Massachusetts General Hospital in 1903, where she was successfully operated upon for tubercular glands of the neck. There has been no recurrence after four years.

In the following year, March 18, 1904, she again appeared at the Massachusetts General Hospital with a history of pain in the right elbow. The following notes were made at that time:

“About one month ago R. P. began to have pain in the right elbow, when she used that arm, and this pain has continued ever since. An attempt to straighten the elbow is unsuccessful, and causes great pain. Heat and swelling have been present during the period when the pain has been noted. The pain is worse at night, and is relieved somewhat by elevating the elbow on the pillow. X-ray examination and internal angular splint advised.

The day after the first examination the patient returned and was re-examined with the X-ray plate for comparison. The elbow gave signs of fluctuation, and the X-ray plate showed foci in the ulna, with a certain amount of disintegration of the joint. Operation was advised but refused.”

The girl went about to the various out-patient clinics of the city, where she was advised to have an operation. She came to me in June, 1904. I advised, and performed immediately resection of the elbow joint.

Examination.—At the time of the operation the elbow was large, swollen and tender. On either side of the olecranon process and the biceps tendon a bulging mass presented which gave signs of fluctuation. A short time before I first saw it, the joint had been punctured on its inner aspect, from which a

mixed infection had resulted, marked by a temperature elevation to 104° , increased tenderness, and constitutional symptoms. *The motions* of the joint, at this time, were limited. The forearm was habitually extended to about 120° , though it could be flexed to 80° , an angular excursion of some 40° . This motion was obtained with great difficulty, and at the expense of eliciting severe pain in and around the joint. As to pronation and supination, the wrist could be twisted from a position of 90° pronation to 45° supination; in other words, rotatory motion at the elbow joint was much limited. The bulging synovial cavity, with the surrounding infiltrated structures, constituted a tumor about four inches in diameter, antero-posteriorly, and about four and one-half inches measured in a lateral plane. The physical signs, therefore, showed advanced disease of the elbow joint with distension of the joint capsule, spasm of the adjacent muscles, and infiltration of the soft parts in relation.

A series of operations was done in this case. The patient was etherized on eight occasions, on all but three of which the procedure was in the nature of an ether dressing: to break up adhesions, or to curette a cavity.

First Operation, June, 1904.—Incisions: These were three and, together formed an H-shaped figure placed in the following manner:

(1) A five-inch incision was made over the olecranon, parallel with the long axis of the bone. This passed through the triceps tendon and muscle down to the capsule.

(2) A second four-inch incision was made parallel with the first over the internal condyle.

(3) A cross-cut connected the two previously made incisions. This was made with the greatest care to avoid wounding the ulnar nerve.

The joint was opened and found to be disintegrated and filled with grumous, infected material. The flaps were reflected, and the disease followed upwards and downwards into the arm and the forearm. The forearm muscles were separated from their attachments to the condyles of the humerus, and subperiosteal resection done four inches above the condyles. The periosteum was left intact nearly to the joint.

The upper halves of the ulna and the radius were riddled with disease, and by curettage and excision the mischief was

cleaned out. The removal of the foci and their extensions required the resection of the head of the *radius* close to the bicipital attachment. Behind this a shell of periosteum remained, as the interior of the bone was scraped away for nearly its upper half. In the *ulna*, complete section was done just behind the coronoid process. From this point a narrow spicule of bone reached back for two inches, until it lost itself in the periosteal cavity which was the relic of the upper half of the *ulna*, after scraping away the disease. The bony bit left behind at the upper extremity of the *ulna* overlapped, by two and one-half inches, the point reached by the periosteal remnant of the *radius*. As will be seen later, the subsequent development of this bony ulnar extremity proved of marked mechanical value in the construction of a tightly-fitting joint. The interosseous nerve was identified during the dissection and preserved. The longitudinal cuts were approximated with interrupted sutures, since the tissues were too infected to allow suture by layers. The cross-cut was left open, and the gap, thus provided, was utilized for drainage purposes. The joint drained for eight weeks and various materials were employed to keep it open while the periosteal cavities were filling; silk-worm gut strands arranged in fagots proved very satisfactory.

The extremity was put up in extension and held there for two weeks. During this time the periosteal sacs had become slightly stiffened, and a move was made to effect more complete isolation of the bones above and below the operative site.

Second Operation, Two Weeks After First.—The patient was etherized and gauze packing insinuated between the upper and the lower arms, thus filling the granulating cavity left at the field of the previous operation. The extremity was again placed in extension, and thus retained for the two weeks following.

Third Operation, Four Weeks After First.—There seemed to be a distinct rigidity discernable in the region of the periosteal shells. The sponge packing was removed, and the bones of the lower arm lifted until their cut ends bore upon the shell of growing bone, which was now replacing the old, and forming the new lower articular surface of the humerus. The overlapping fragment of the *ulna* was passed by the humerus to the inner side, thus permitting the approach of the *radius* to and its articulation with the humerus.

The extremity was fixed in a position of acute flexion. In

this posture the bones were immobilized for two months by means of internal splints angular to various degrees of acuteness. Passive angular and rotary motions were undertaken two days after the third operation, the arm being restored to the splint after the exercise.

Ether was given subsequently five times, as alluded to earlier, sometimes with the intention of freeing adhesions, at others of loosening tags of detritus caught in the sinus.

End Results.—There is a *shortening* of four inches in the affected arm. An effort was made at the first operation to save part of the epiphyseal line on the ulna, but it is doubtful whether it was successful. If my measurements do not deceive me, during the past year the difference in length of the two arms has been reduced nearly one inch.

Motions: Rotatory is perfect. In pronation the projecting ulnar process hugs tightly the humerus, thus gaining a *point d'appui*, so that the spiral rotation of the radius over the ulna causes no lateral displacement or wobbling. Perfect supination is present.

Angular Motions.—Flexion—to 36 degrees; extension—to 150.5 degrees.

Motions of the Fingers.—These are perfect, strong extension and flexion, being both accomplished with freedom.

The Mechanism of the Joint.

Angular Motion.—As a whole, *during extension*, the ends of the forearm bones rest near the upper edge of the notch in the humerus. The ulna, at this time, is separated from the humerus for about one-quarter inch; the end of the radius remains attached to the ulna, but in front of the humerus. As the arm is flexed the radius and the ulna are pushed backwards and downwards; backwards until close articulation with the humerus occurs, whence it glides downwards for about a half inch along the curve of the socket, where it rests during the completion of flexion.

Rotary Motion.—In supination the radius lies in front of the humerus, slightly to the inner side, in close relation with the ulnar end. At this point the ulna forms a hook and articulates with the other two bones as follows: the lower half

of the hook supports the radius, and provides a fulcrum for the same, quite similar in principle to the relationship of these bones in a normal joint. The upper half of the hook bears upon the humerus. *When pronation occurs* the new radial head turns in its new bed, while the shaft twists over and to the inner side of the ulna. This twist pushes the ulnar hook outwards until it meets the humerus, when ulna and humerus lock firmly together, and here they remain, in close embrace, while complete pronation is effected.

Conclusion.—No general conclusions can be drawn from one case. It would seem, however, that a good mechanical



FIG. 1. Cross section.
Extension. Supination.



FIG. 2. Cross section.
Flexion. Supination.



FIG. 3. Cross section.
90° Flexion Pronation.

outcome should generally follow the employment of the technique described above, since this successful result was obtained in the face of unusual difficulties. The widespread tubercular involvement of the bones and the soft parts, the mixed infection, and the indolence of the reparative process, presented a discouraging picture. In cases of ankylosis in which the original infection had subsided, these primary obstacles to success would be minimized.

Many attempts have previously been made to obtain a fulcrum for the play of the arm bones. The introduction of soft parts between the bony articulating surfaces may prevent ankylosis, but it cramps the motions by omitting to provide for a socket.

The obvious disadvantages of a flail joint need no comment. The two factors which contributed chiefly to the restored elbow function of my case were: (1) the new socket in the humerus, (2) the firm grasp of the humerus by the hook of the ulna.

It is now three years after operation, and the girl is working in a factory eight hours a day, and often carries heavy weights up and down stairs with the operated arm. The gross and the X-ray photographs are explained by their legends.

FIG. IV.



Final result of arthroplasty of right elbow, Lateral view, extended to 150.5° 1907, 3 years after operation.

FIG. V.



Final result of arthroplasty, right elbow. Lateral view, flexed to 36° , 1907. Complete flexion.

FIG. VI.



Arthroplasty, right elbow. Lateral view, flexed to 41° , corresponds to Fig. V. Note relation of forearm bones to tip of humerus.

FIG. VII.



Arthroplasty, right elbow. Lateral view, extended to 150.5° , 1907, corresponds with Fig. IV. Note: separation of bones during extension, scattered bony deposits about joint, tip of ulnar process slightly overlaps humerus.

FIG. VIII.



Arthroplasty, right elbow. Antero-external-posterior view, extended to 150.5° , viewed from behind: 1907, corresponds with Fig. IV. This view is not exactly a front one, but is taken somewhat from the outside as well. This throws the shadow of the forearm bones to the inner side, but it brings out the hook of the humerus. Note hook of ulna, with its radial articulation, also end of radius. The irregularities are undoubtedly filled with soft parts.

OLD UNREDUCED POSTERIOR DISLOCATIONS OF THE SHOULDER.

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THE importance of the long tendon of the biceps, in preventing and maintaining reduction in certain cases of dislocation of the shoulder, has generally escaped attention. It seems probable that in posterior dislocations of the shoulder the long tendon of the biceps may be torn from its groove between the tuberosities of the humerus and, on account of its displaced position, not only interfere with the reduction of the dislocation, but may displace the head of the humerus after reduction has been accomplished.

CASE.—A posterior dislocation of the head of the humerus was reduced three times during the first month after the accident occurred. Reduction was accomplished at each attempt, but the dislocation promptly recurred. Examination eight months after the injury showed the biceps tendon displaced from its groove and passing directly from its origin over the centre of the glenoid fossa. No bloodless reduction was attempted at this time. The joint was exposed; reduction accomplished; the displaced tendon of the biceps put into place and retained between the tuberosities by means of a periosteal bridge, and the soft parts repaired as much as possible. At this time, one year after the operation was performed, the extremity is useful and painless.

Alexander W., a clerk thirty-eight years of age, was thrown from a bicycle during July, 1905, producing a posterior dislocation of the right shoulder. Reduction was accomplished without the use of general anæsthesia. Examination one week later showed that the dislocation had recurred. A surgeon was called in, who reduced the dislocation under general anæsthesia. Recurrence was prompt, and in two or three days reduction was again accomplished under general anæsthesia. It was said that the last reduction was difficult and prolonged. In a week the bones were

again found out of position, but no attempt was made to put them in place.

The extremity was painful and practically useless. During the next few months the pain increased in severity and the muscles became atrophic, although massage and passive motion were employed.

I saw the patient with Dr. A. N. White, of Denver, Colo., about eight months after the injury occurred. At this time the dislocation was easily made out, and it could be determined that the long tendon of the biceps no longer occupied its normal position in the groove between the tuberosities of the humerus, but passed from its origin directly over the glenoid fossa of the scapula. There was no sensory or motor paralysis.

Operation was performed March 12, 1906. The joint was exposed by a deltoid flap, dividing the deltoid near its insertion and turning the muscle upward. The head of the humerus was found in the subspinous fossa. The supraspinatus, infraspinatus and a portion of the teres minor were detached from the greater tuberosity. The long tendon had been torn from the bicipital groove and the transverse ligament had been destroyed. The capsule of the joint had been detached from the head of the humerus and was contracted into a cicatricial mass about the glenoid cavity. It was incised and pushed out of the way sufficiently to clear the glenoid fossa. Reduction was then attempted but could not be accomplished. It was found that the subscapularis, which had not been torn from its insertion, prevented reduction. This muscle was divided in sections close to the lesser tuberosity. The dislocation was now reduced. The biceps tendon was placed between the tuberosities and a flap of periosteum sutured over the tendon to hold it in place, making, as it were, a new transverse ligament. It was impossible to repair the joint capsule. Some of the cicatricial tissue, together with a portion of the fascia of the under surface of the deltoid, was sutured to the periosteum over the tuberosities to assist in maintaining reduction. The deltoid was united with catgut and the wound closed without drainage. The arm was held in abduction with a plaster dressing.

Ten days later the dressing was removed and the wound found to be healed throughout. The arm was gradually brought down to the side. Passive movements and massage were resorted

to and voluntary motion was encouraged during the third week following the operation. Two months later the patient had very good control of the extremity. Flexion and internal rotation were normal, but outward rotation was somewhat limited and abduction very slight. The strength and range of motion gradually increased so that six months after the operation was performed the extremity was sufficiently serviceable to accomplish ordinary work. One year after the operation the patient states that "the arm is as good as the other one." This statement must be modified. I recently examined the patient and found a very useful extremity indeed, but found abduction limited to the horizontal position. Further abduction is accomplished by an upward rotation of the scapula and not by movement at the shoulder joint. The deltoid is weak but does not seem atrophic. The remainder of the extremity is apparently normal. The shoulder and arm have not been painful at any time since the first week after the operation.

The reports of cases of old unreduced posterior dislocations of the shoulder are so few that it is impossible to draw definite conclusions regarding the indications for operative treatment, or the operative procedure that is best suited to these patients. It is generally agreed that operation should be done when bloodless methods fail to reduce the dislocation, and if operation is necessary, early operation is desirable. Not all surgeons deem it advisable to perform early operations in these cases. According to J. E. Mears¹ many operators, especially English surgeons, advise operating six to eight weeks after the dislocation has occurred. Souchon,² who in 1897 made an exhaustive study of old unreduced dislocations of the shoulder, states that, "It goes without saying that no operation should be attempted before all possible means of bloodless reduction have been conscientiously applied in recent as well as in old irreducible or unreduced dislocations." There may be exceptions to Souchon's statement, and it would seem, from the case herewith reported, and a consideration of the anatomy about the shoulder joint, that a displacement of the long tendon of the biceps, which may occur in backward

dislocations of the shoulder, is a condition that demands a violation of this very good rule. If in a posterior dislocation of the shoulder it can be determined that the long tendon of the biceps has been torn from the bicipital groove operation should be done at once. Even if reduction can be accomplished by manipulation the abnormal position of the tendon, passing over the shallow glenoid fossa, will, when the biceps is contracted, force the head of the humerus out of its normal position.

The literature on this subject throws no light on the importance of the biceps tendon in these cases. Briddon, Reid,³ Adams,⁴ and J. H. Brinton,⁵ who have reported operated cases of old unreduced posterior dislocations of the shoulder, do not mention the biceps tendon and do not speak of rupture of the transverse humeral ligament.

TYPE OF OPERATION.

Resection of the head of the humerus has been the operation performed in three out of the four cases of unreduced posterior dislocations of the shoulder operated upon. Briddon and Adams report "good" results following resection in their cases; while Reid states that three months after the operation abduction was limited, but the patient had been benefited by the operation. J. H. Brinton produced a fracture of the humerus, with a resulting false joint, in his case and reports a "good result." All of these reports are indefinite regarding the pathology of the dislocations, the description of the operations, and the results obtained.

A study of the reports of unreduced dislocations of the shoulder—other than the posterior variety—suggests that operation is indicated in posterior dislocations when bloodless methods fail to accomplish reduction, and in all cases in which it can be determined that the biceps tendon has been torn from its groove; and that reduction is preferable to excision or other operative procedures. The subcutaneous division of adhesions, recommended by the French, should be supplanted

by free exposure of the parts. Of the many methods advised in operating on these cases, the one turning up the deltoid in the flap gives the best exposure of the shoulder joint and the surrounding structures. The straight or slightly curved incisions are preferred by some operators. The long anterior incision seems to be the one of choice in treating old unreduced anterior dislocations of the shoulder.

I was surprised that I could find the reports of only four cases of old unreduced posterior dislocations of the shoulder treated by operation.

CASE I.—Bridson reports a subspinous dislocation of the head of the humerus in which manipulation failed to accomplish reduction. The head of the bone was resected. The result is described as being "good," but no details are given.

CASE II.—Reid treated an old unreduced posterior dislocation of the shoulder by resecting the head of the humerus. Three months later the arm was freely movable with the exception of abduction which was limited.

CASE III.—Adams resected the humeral head in a posterior dislocation of the shoulder that could not be reduced by bloodless manipulation. The patient, who was a porter, was able to perform his duties without difficulty a few months after the operation was performed.

CASE IV.—Brinton, being unable to reduce an old posterior dislocation of the shoulder, exposed the joint by using a V-shaped incision. Reduction was not accomplished, but a fracture was produced below the head of the humerus making a false joint. He reports a "good result."

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PARTIAL LOSS OF THE TIBIA REPLACED BY
TRANSFER OF THE FIBULA, WITH MAIN-
TENANCE OF BOTH MALLEOLI OF
THE ANKLE.*

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W. B., a boy five years old, had in June, 1904, an acute dissecting periostitis beginning at the lower end of the right tibia and in six days stripping the bone nearly as far as the patellar tubercle. Owing to sloughing of the periosteum after the removal of the shaft the tibia regenerated very imperfectly. Nine months after the onset of the trouble the bone had reformed for about an inch and a quarter from the upper end. There was then a gap of about an inch, below which was a thin strip of bone two inches long, reaching down to within about half an inch of the lower epiphysis from which a little new bone had grown upward. The fibula was normal. The appearance is shown well in the radiograph taken at that time (Fig. 1).

In August, 1905, thirteen months after the onset of the trouble, the boy was admitted to the General Surgical Service of the Children's Hospital for operation. Since ten weeks after the trouble began he had been going about with a plaster bandage and Thomas knee splint.

The attachment of the upper end of the fibula had become loose so that the head of the bone could be shoved upward slightly and the foot could be moved inward for about two and a half inches. There was marked shortening of the leg, varying with the position in which the foot was held. The foot was a little smaller than on the sound side. The fibula had become somewhat hypertrophied, particularly at the middle of the shaft. All wounds were solidly healed (Fig. 2).

It was decided to transfer the fibula into the gap in the tibia.

* From the General Surgical Service of "The Children's Hospital," Boston, Mass. (Service of Drs. H. L. Burrell, H. W. Cushing, and J. S. Stone.)

The upper end was transferred first. A vertical incision about three inches long was made directly over the lower end of the upper sound portion of the tibia. The cut was made directly through the periosteum which was separated on the fibular side for a vertical distance of about two inches. The muscles were then separated along the interosseous membrane until the fibula at the same level was exposed. In order to reach the fibula more readily a second incision about an inch and a half long was made directly down onto the bone on the outside of the leg. At a point about two inches from the upper end the fibula was then cut across with a chain saw. The upper end of the lower fragment was then inserted into a mortise cut in the tibia. This mortise was cut at a level slightly lower than that at which the fibula was cut across in order to gain length if possible. The periosteum was reflected from that side of the fibula which rested in the mortise. The reflected periosteum of tibia and fibula were then sutured together with chromic catgut to maintain close apposition, and the reflected periosteum of the tibia was further sutured as a cuff around the upper end of the fibula to hold it more securely in position. The muscles were then allowed to slip back into their former positions as far as possible. A few dead spaces were closed by catgut sutures uniting the fasciæ. The incisions were closed without drainage. A sterile dressing and plaster bandage were applied.

An X-ray taken through the plaster three weeks after operation showed that the position of the bone had not changed. After four and a half weeks the boy went to the Convalescent Home. Eleven weeks after operation the plaster was removed. Moderately firm union had occurred. The X-ray showed the upper end of the fibula had been driven upward slightly into the medullary portion of the tibia. A new plaster was applied.

The boy was readmitted to the hospital in January, 1906. At that time the union between the upper end of the tibia and the fibula had become absolutely solid and the shaft of the fibula had materially increased in thickness (Fig. 3).

Five and a half months after the first operation a longitudinal incision was made anteriorly over the outer part of the lower end of the tibia. The bone was exposed. By careful dissection the lower end of the fibula was then exposed through the same incision and with a chisel it was split horizontally for a distance of

nearly four inches. Great care was taken to avoid separating the periosteum from either half of the bone. At the lower end of the split made in the bone the inner half was cut across transversely at the level of the upper part of the remaining lower epiphysis of the tibia. A small pocket was then cut in the cartilage covering the end of the tibial epiphysis just large enough to receive the inner half of the fibula. The inner half of the fibula was then sprung into its new position in the tibia. In doing so the outer half was broken at its upper end but was still held in place by the periosteum. The inner half remained intact and was retained in its new position by the tension of the muscles. The fascia forming the muscular sheath was sewed with catgut and the skin was closed without drainage. A sterile dressing and plaster of Paris bandage from the toes to the thigh completed the dressing. Three weeks after operation the child was sent home with the plaster bandage not disturbed. An X-ray showed that the bones remained in place.

After three months the plaster was removed. A small granulating spot was found at the lower end of the incision. Bony union was solid. Five days later a small spicule of necrotic bone about three-quarters of an inch long was discharged. After this the skin healed solidly. A month later the boy began to walk on his leg, and ever since has used it without restraint (Fig. 4).

NOTE.—For the series of radiographs which show the conditions better than words can express them I am indebted to Dr. A. W. George, the radiologist of the Hospital.

The problem presented in this case was the restoration to usefulness of a leg in which the fibula was sound, the upper end of the tibia was sound, and in which the lower epiphysis of the tibia remained, but without any shaft above it for a distance of 12 cm., nearly five inches. As might be expected a talipes varus was developing because of the lack of support for the inner side of the foot. The utilization of the fibula to take the place of the tibia seemed the obvious means of relief. The hypertrophy of the fibula, shown in the second set of radiographs, which came on when no weight was being borne upon the leg and when the boy was walking about with a Thomas knee splint, confirmed the hope that the hyper-

FIG. 1.



Antero-posterior view.

Lateral view.

Radiographs taken nine months after the removal of the shaft of the tibia. The amount of regeneration is well shown.

FIG. 2.



Antero-posterior view.

Lateral view.

Radiographs taken a year after the removal of the shaft of the tibia. They show that no further regeneration of bone had occurred since the preceding X-rays were taken. They show, however, the beginning hypertrophy of the shaft of the fibula, most pronounced about the middle.

FIG. 3.



Antero-posterior view.



Lateral view.

Radiographs taken five months after the first operation. Solid union but slight impaction of fibula into medullary cavity of tibia.

trophy would continue if the functional use of the bone were increased.

The operative procedures especially in the first step were easy. The field of operation was made bloodless by a tourniquet which, however, was removed before the wounds were closed. The utmost care was taken to avoid injury to any nerves or vessels. In cutting across the upper end of the fibula great care was taken to avoid injury to the periosteum. In cutting out the mortise in the upper part of the tibia advantage was taken of an existing hollow in the bone, but the utmost pains were taken in separating the periosteum to avoid tearing it. A side of the fibula bared of periosteum was placed in a freshly cut mortise in the tibia. Bare bone was thus placed next bare bone, while periosteum was sutured to periosteum. A mistake was made in cutting the hole in the tibia a little too deep. The fear was that the fibula might not remain in its position. The fact was that the muscular pull crowded the bone upward into the medullary cavity. If the experience in this case is of value it would seem wise to cut the mortise only so deep that the cortical layer of the entering bone cannot sink inside the cortical layer of the receiving bone.

The second step was more difficult than the first. It was necessary to maintain connection between the shaft of the fibula and the external malleolus. If this was lost the outer side of the ankle joint would have been seriously weakened. At the same time it was necessary to bring a portion of the fibula above the lower epiphysis of the tibia. The greatest care was used in splitting the fibula. The periosteum was first cut with a sharp knife. Then in part with a small chisel, in part with a stout knife the bone was divided. Each half of the bone had a thickness of only 4 mm., scarcely over an eighth of an inch, yet in separating them for a distance of about three inches, 8 cm., it was essential that the periosteum remain adherent to each portion and that an equal thickness of each part be maintained throughout. It was planned to spread the halves without breaking either. This proved impossible. Fortunately the outer rather than the inner half gave way

close to the upper end of the split between them. In another case it would seem wise to insure a break in the outer half at this point rather than run the risk of breaking the inner half or the outer half at a lower level. The promptness and the extent of the new bone formation from each of the halves were surprising. The trifling amount of necrosis was gratifying.

The continued increase in the size of the transferred bone is most striking, and corresponded in amount with the freedom of use which was allowed. The last radiograph (Fig. 5) was taken after the boy had been using the leg for nine months without any restraint whatever and without any discomfort or disability at all.

In any similar case more prompt transfer of the bone would seem advisable. Nothing was gained by the delay. The length of time allowed between the steps of the operation might also have been shortened.

The result is one of perfect functional usefulness. There is a shortening of 4.2 cm. measured in the radiograph ($1\frac{5}{8}$ inches) which corresponds with the ordinary clinical measurements. The lower ends of the tibia and fibula are growing symmetrically. While it is not possible to say absolutely how great an interference with growth there may be in the future the present indications are that it will be very slight and will not interfere at all with normal functional use.

FIG. 4.



Radiograph taken of both legs nearly two years after the removal of the shaft of the tibia, about four months after the fibula was split and the inner half was inserted in the tibia. There is a shortening of exactly 4. cm. (one and a half inches). About one half of this is due to retarded growth, while the other half is due to a crowding up of fibula into the medullary cavity of the tibia.

Note the hypertrophy of the transferred portion of the fibula and compare it with the atrophy of the upper useless end of the fibula. Note the thickening and firm union of the lower divided halves of the fibula. The normal relations of the malleoli and lower end of the tibia are retained. The spot from which the small sequestrum was discharged is shown at the inner side of the bone just above the lower epiphysis of the tibia.

FIG. 5.



Radiograph taken in February 1907, two years and eight months after the removal of the tibia,—nine months after the preceding radiograph. The tremendous increase in the diameter of the transferred fibula occurring under the stimulus of functional use is strikingly shown. Accurate measurements of the radiographs show that the tibia of the normal side has grown 1.1 cm. in length in nine months while the bone on the other side has grown .8 cm. in the same period. In other words, the interference with growth at the lower epiphyseal line of the tibia has been only .3 cm. in nine months. There has been no change in the relations between the lower epiphyseal lines of the tibia and fibula. There is no tendency toward the development of a talipes varus or talipes valgus.

FRACTURE OF THE TARSAI SCAPHOID BONE.

WITH REPORT OF THREE CASES.

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FRACTURE of the tarsal scaphoid bone is of infrequent occurrence. The standard text-books on fractures do not mention it, though Bloodgood, writing in Saunders' Medical Hand-atlas, recognizes fractures of the tarsal bones other than the astragalus and os calcis.

Prior to the advent of the Röntgen-rays, Kohlhardt¹ reported a case of fractured scaphoid. Later, Bahr² recognized luxations of the bone, and reported 7 cases. The accuracy of these diagnoses is considered doubtful by later writers. In 1905, Bergmann³ described 3 cases, and proved his diagnosis skiagraphically.

The scaphoid bone, situated at the inner side of the tarsus, articulates behind with the astragalus, and in front with the three cuneiforms. The number of joints into which it enters, combined with the important position of the bone in the plantar arch, make injuries to it seriously disturb the integrity of the latter structure, and render the prognosis very guarded.

Fractures of this, as of the other tarsal bones, usually occur after falls from a height, the patient landing on the toes with the foot in plantar flexion. This indirect force transmitted from above presses the bone between the astragalus and cuneiforms, and tends to drive it forward. Owing to its bracing by the plantar ligaments, its close articulations, and its great dorso-plantar diameter, the bone is usually crushed before this takes place. Isolated dislocation has not been observed since cases began to be studied by the X-ray. With greater force the fragments slip forward under the tendons on the dorsum of the foot, and the astragalus is pushed into their place.

On physical examination, the foot is seen to be swollen

and apparently broadened. Bergmann, in his three cases, found shortening of the inner edge of the foot, amounting to about 0.75 cm. Tenderness and crepitus can usually be elicited anterior to and a little below the malleoli. In cases with dislocation, the displaced fragments can be felt as a prominent knuckle on the dorsum of the foot. The usual clinical diagnosis is fracture of the astragalus.

The best method of diagnosis is by skiagraph, taken as usual for lateral views of the foot, with the external malleolus resting on the plate. A fair view of the bone can also be obtained in the antero-posterior direction. The principal line of fracture is found, as a rule, to follow the long axis of the bone, the two resulting fragments being further comminuted and displaced forward or inward, following the lines of least resistance. The normal foot should also be skiographed for comparison. The importance of this is illustrated by Momburg's⁴ case. Disability was claimed one year after a slight injury. A skiagraph showed the scaphoid to consist of two pieces. There was, however, no effort at callus formation, and a control picture of the other foot showed a smaller piece in a similar location. The patient being overweight and showing in addition flattening of the arch, on both sides, the symptoms were ascribed to this and the indemnity was not granted. This whole question of supernumerary bones in the tarsus requires further investigation. Another example is seen in the so-called "os trigonum tarsi."

Treatment should aim first at the reduction of the fracture. For this Bergmann recommends the following technique: under ether the toes are grasped and extended, the foot flexed plantarward and abducted. This manœuvre tends to increase the distance between the astragalus and the cuneiforms, and pressure on the dislocated fragments may now replace them. If the irregularities of the fragments make this impossible, Bloodgood⁵ suggests an incision for reduction.

The apparatus used should have for its primary object the support of the arch. Bergmann rejects the complete cast as inapplicable on account of the swelling in early cases, and rec-

FIG. 1.



Case I.—Note forward displacement of scaphoid, and relation of astragalus.

FIG. 2.



Case II.—Note comminution and forward displacement of fragments.

FIG. 3.



Case 3.—Showing longitudinal fracture of bone.

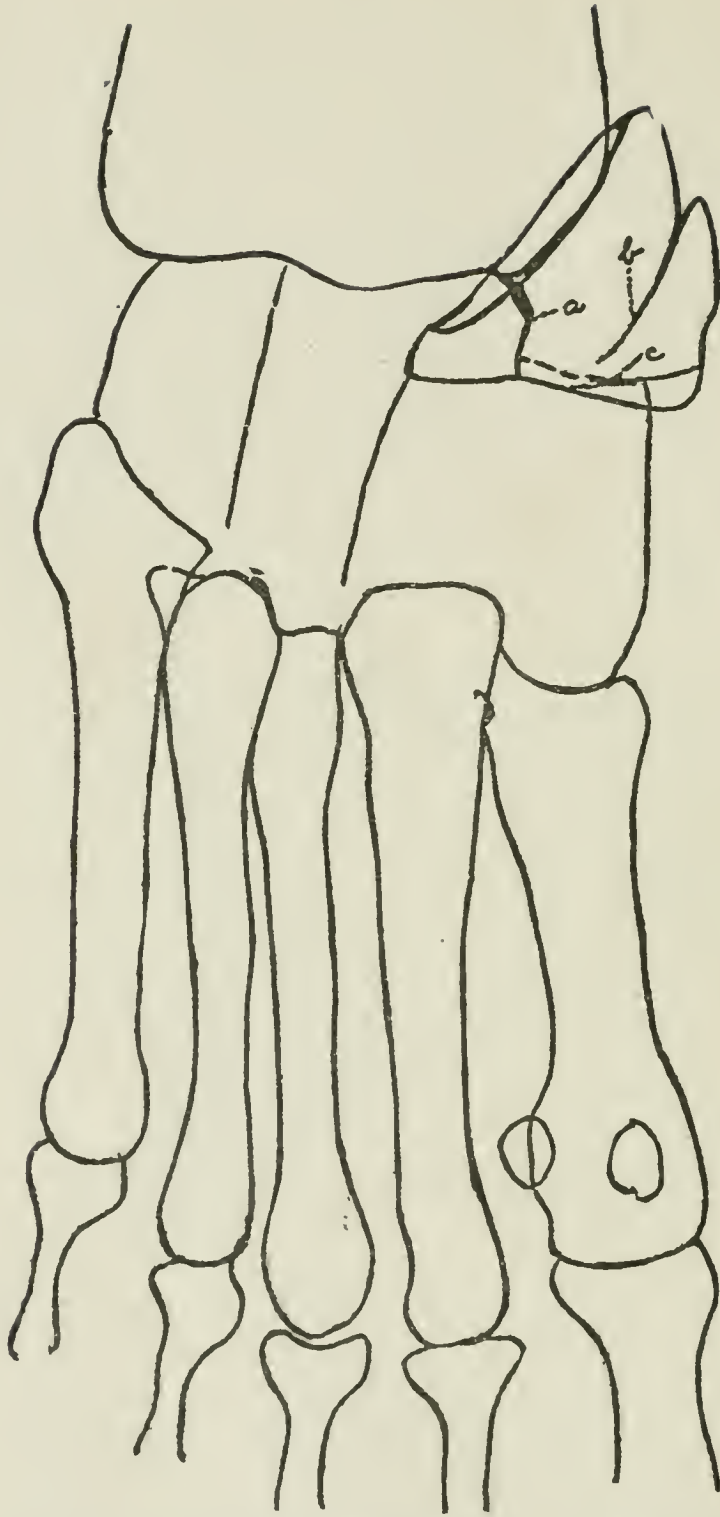
ommends a strong plantar splint of plaster, extending from the toes over the sole to the upper third of the leg, and well molded over the arch. Over this is applied a firm bandage with much wadding. This dressing allows of daily removal of the bandage for massage and bathing of the foot, a procedure which this author considers very important. After firm union has been obtained, a flat-foot plate should be worn for a long period.

Prognosis should be guarded in every case. Traumatic flat-foot, with its accompaniments of pain, edema, and varying disability, is very likely to develop. Especially in the unreduced cases the ultimate function is bad. It must be borne in mind that by this fracture the capability of two of the great weight-bearing joints of the foot, the talo-navicular and naviculo-cuneiform, is practically destroyed.

CASE I.—C. H. B., lineman, aged 30, fell from a telegraph pole in October, 1905, landing heavily on both feet. He was brought fourteen miles to the Worcester City Hospital, where, a few days later, skiagraphs were taken. These showed on the right a badly comminuted ankle-joint, tibia, fibula, and astragalus all being involved. On the left, the scaphoid was broken into several pieces and driven forward under the tendons on the dorsum of the foot, the astragalus being shoved forward to take its place. Treatment consisted in reduction and immobilization in plaster, continued six weeks. Toward the end of this time flat-foot plates were applied to both feet. On December 17 the patient left the hospital, the record stating "Motions at ankle good," and I have been unable to trace him. If this case were seen fresh to-day, I should recommend Bloodgood's operation (Fig. I.)

CASE II.—N. F., teamster, aged 23, stepped backward into a hole in a roof, and fell about 20 feet to a pile of bricks, striking on both feet with knees semi-flexed, on October 28, 1906. The left ankle at once became swollen and painful, and he was taken to the Worcester City Hospital, where swelling, ecchymosis, tenderness, and crepitus below the malleoli were noted, and a diagnosis of fractured astragalus made. A skiagraph taken next morning showed the following condition: Scaphoid comminuted with slight forward dislocation of fragments. Astragalus pushed slightly downward. (Fig. II.)

FIG. 4.



Case III.—Antero-posterior view. (tracing). (a) Principal fracture line. (b, c) Lines of fissure.

Plaster was applied, and continued for about four weeks, after which patient was allowed to use his foot.

On February 14, 1907, three and a half months after the injury, his condition was as follows: Marked thickening at the site of the bone on the dorsum and inner side of the foot, apparently due to callus formation. Motions at the ankle are free and painless, except inversion, which causes some pain. Patient says that the foot easily becomes tired. After a hard day's work it becomes edematous and cyanotic, and the veins become prominent. Pain appears at the site of the fracture, sometimes radiating up the leg, and severe enough to interfere considerably with his present work as collector.

A skiagraph taken at this time showed the bones about as in the first one, with some loss of detail, probably due to callus. A flat-foot plate, designed to hyper-correct the evident flattening of the arch, was applied, with immediate and continued relief. The patient is still wearing it (May 4).

CASE III.—J. J., nurse, aged 21, leaped from a window in a fit of melancholia on March 4, 1907, striking with both feet on the frozen ground. She afterward complained of pain in the right foot, and a bandage was applied, but little else was done until four weeks later, when Dr. B. T. Burley was called as consultant on the nervous symptoms. He examined the foot, and, having heard cases I and II reported before a local society, made the clinical diagnosis of fractured scaphoid. By his advice the patient was sent to Memorial Hospital and skiagraphs taken (Figs. III and IV). Physical examination showed marked tenderness on the dorsum and inner side of the foot, over the site of the bone. No crepitus could be elicited.

The skiagraphs showed the longitudinal fissure line with unusual distinctness, there being also some comminution of the fragments.

A plaster cast was applied from the toes up, and worn two weeks, when it was replaced by a bandage. At the present writing (May 4) the foot appears normal, but the patient is still on crutches, and refuses to put it to the floor. The mental condition renders careful examination difficult.*

* July 27. Patient's mental condition has improved, and she reports foot "as well as ever, except for swelling after unusual exertion." Is wearing no apparatus.

I am indebted to Drs. Homer Gage, Marsh, and Burley for the privilege of reporting these cases, which occurred on their services. The histories are compiled from the records of the Worcester City and Memorial Hospitals.

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- ⁵ Bloodgood. Loc. cit.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, May 8, 1907.

DR. JOSEPH A. BLAKE, President *pro tem*.

STAB-WOUND OF THE SPINAL CORD.

DR. WILLIAM G. LE BOUTILLIER presented a boy, seventeen years old, a plumber, who was admitted to the J. Hood Wright Hospital on March 27, 1907, in the service of Dr. Howard D. Collins, with the history that shortly before his admission, during a quarrel, he was stabbed in the back of the neck. He dropped to the pavement, but did not lose consciousness.

The boy was immediately brought to the hospital, and upon examination he was found to be conscious, but in a condition of considerable shock. He was unable to move either his arms or his legs. There was a small incised wound in the left occipital region. This wound, from which only a few drops of blood had escaped, was probed by the assistant house surgeon, and he stated that the probe passed along the occipital bone and then downward and inward to a depth of about four inches, extending to the cervical vertebræ. The wound was about half an inch in length. When Dr. Le Boutillier came on duty, there was still complete paralysis below the clavicle. The pupils were equal, and reacted to light and accommodation. There was no strabismus nor facial paralysis. The tongue did not deviate. The voice was husky, and the patient could not speak above a whisper. There was no impairment of deglutition nor articulation. There was no bleeding from the ears, nose or pharynx. The left trapezius and sterno-cleido-mastoid muscles were paralyzed, and the patient was unable to move his neck. The head was drawn slightly to the right side. There was paralysis of the external respiratory muscles on the left side. The patient breathed entirely

with the right side of the chest. There was no diaphragmatic respiration on the left side. There was complete flaccid paralysis of the left arm and leg, with spastic paralysis of the right arm and leg. The knee-jerk and cremasteric reflexes were absent on the left side; about normal on the right side. There was no loss of tactile sensation on either side of the body or in the extremities. No priapism. No apparent injury to the vertebral column was determined. Abdominal and thoracic viscera negative. Temperature on admission, 97.8; pulse, 84; respirations, 26.

The patient was kept in bed, and external heat was applied. He twice vomited small amounts of undigested food, but complained of no pain. From the onset, defecation and micturition were involuntary. For the first few days after his injury, there was no noticeable change in the symptoms, except profuse frothy expectoration lasting about a week. The wound in the neck healed on the second day. On April 2, the patient had complete loss of motion as noted above. He responded to touch everywhere equally well. Temperature and pain sensations were somewhat disturbed, especially on the left side of the body. Along the upper part of the neck and under the chin there was quite a definite area of hyperæsthesia. On the upper left part of the occipital region there was a small area, about two inches in diameter, of apparently absolute anæsthesia. There was some dysphagia, and inspection showed some paralysis of the pharyngeal muscles. The right pupil was larger than the left.

On April 8 the patient's general condition was good. There was no decubitus. There had been no improvement in the paralysis. The reflexes which had hitherto been absent, were now present and exaggerated. About April 17th there was beginning return of voluntary motion in the feet and fingers. On April 26th the patient first became conscious of a desire to urinate, and he began to acquire slight power in its control. Defecation was still involuntary. He was now able to flex the right leg to a right angle with the thigh, and the left forearm nearly to a right angle. Power to rotate the legs was slight, but equal. The power of grasp in each hand was very slight, and apparently equal. The patient now responded accurately and normally to pain and temperature stimulation on the left side of the body, but there was still considerable confusion on the right side.

On May 2, 1907, with some slight support to the arm, the

patient could now carry his left hand almost to the mouth. The ability to extend the hand was not so good. The right thigh could be well flexed on the abdomen, and the leg on the thigh. Power in the right arm and left leg was only slightly increased, and was very weak compared with that in the other two extremities. There had been no trophic disorders at any time, and the general condition of the patient was excellent.

DR. JOHN A. HARTWELL, in speaking of the differential diagnosis between a direct stab-wound of the spine and hæmorrhage in the case shown by Dr. Le Boutillier, said there were several points that favored the latter view. He could recall three cases in which a diagnosis of subluxation of the spine had been made on account of immediate paralysis following the injury in which the symptoms subsequently proved to be due to hæmorrhage. In all those cases, the paralysis was almost instantaneous, and the fact that Dr. Le Boutillier's patient was immediately paralyzed did not throw out the diagnosis of hæmorrhage.

The second argument against a possible severance of the cord in this case was the rapid improvement; this had occurred within three weeks, which was much sooner than would have been expected even after the suture of a nerve with a neurilemma, while it would certainly be unusual in the spinal cord, which had no neurilemma, upon which regeneration depended.

Dr. Hartwell said the direction of the stab-wound in this case was also inconsistent with the idea that the cord itself was wounded. He was inclined to attribute the paralysis to the pressure effects of a hæmorrhage. The unusual distribution of the sensory symptoms also suggested the possibility of a neurosis.

DR. THEODORE DUNHAM referred to one case coming under his observation in which the symptoms were somewhat similar to the one shown by Dr. Le Boutillier. The patient was a boy of nine years with a spina bifida. He had had several attacks of paralysis of varying degrees, the effects of which had passed off in the course of time. One day, while seated in a wheeled chair, he suddenly fell out, and when he was picked up he was almost completely paralyzed, although he still had control of one arm. He was brought to the hospital and for three or four days was in a more or less stupefied condition, and when that passed off, his paralysis was still more evident. After about three weeks there was slight motion in the paralyzed limbs, in which he had

since then gradually regained power. There was no history of trauma, and the case was regarded as one of hæmorrhage into the cord.

STRANGULATED INGUINAL HERNIA IN A SEVEN WEEKS' OLD INFANT.

DR. LE BOUTILLER presented a boy, seven weeks old, who was admitted to the J. Hood Wright Hospital on April 22, 1907, at 5.30 P.M., with the history that he had a "lump in his groin." The mother stated that on the day prior to his admission he had had no stool and had cried considerably, as though in pain. Upon examination she found a swelling in the right groin which seemed tender. Toward evening the child began to vomit and continued to do so at intervals during the night and the following morning.

Upon examination at the hospital, the abdomen was rather rigid, and in the lower right inguinal region there was a slight fulness extending over Poupart's ligament and down into the scrotum, which was swollen, reddened and tender. The mass itself was fairly soft, and felt as though it contained fluid or gas, and was apparently connected by a pedicle with the abdominal cavity.

The patient was immediately removed to the operating room, and a three-inch incision was made from just below the anterior superior spine, passing obliquely downward to just below the inner part of Poupart's ligament. The skin and fascia were retracted, and the protruding hernial sac freed from the cord and opened. It contained no fluid, but about five inches of small intestine, which was adherent to the end of the sac. The adhesions were broken up, and a small area of the gut, about one-quarter of an inch in diameter, which was lustreless, black and almost gangrenous, was inverted with Lembert's sutures, so that the knuckle made by turning in the affected area ran transversely to the long axis of the gut. The gut was then returned to the peritoneal cavity and the sac excised, one chromic catgut suture being inserted to approximate the aponeurosis about the external ring. The wound was closed with interrupted sutures.

Following the operation, the child was restless and cried a good deal during the night, and had several slight attacks of vomiting. On the afternoon of the day following the operation the temperature suddenly rose from normal to 104, and then

as rapidly returned to normal. The wound healed by first intention, and after the first day the child nursed and slept well, and seemed comfortable. The bowels moved regularly once or twice daily, and there was no evidence of any intestinal discomfort or trouble. The patient was discharged cured on April 27, 1907.

A PRELIMINARY REPORT ON THE TREATMENT AND CURE OF CANCER BY THE USE OF THYMUS GLAND.

DR. FREDERICK GWYER read a paper with the above title for which see page 86.

DR. BLAKE, after examining the patient, said there was still a distinct mass over the clavicle and another in the left pectoral region.

DR. JOHN ROGERS said he had had quite a little experience with the use of these foreign substances, and one serious difficulty he had encountered was that a human being would acquire immunity to calf thymus in a moderately short period of time, and it was necessary to increase the dose rather rapidly.

DR. GWYER said the tumor in the pectoral region referred to by Dr. Blake was an enlarged gland which was formerly as large as his thumb, but had now almost disappeared. The other mass might possibly be fat.

In reply to Dr. Rogers, the speaker said that while perhaps a patient might acquire tolerance to the administration of the gland, he thought that point would not be reached before the onset of the auto-intoxication which would necessitate an intermission in the course of the treatment. During this period of rest, it was probable that the acquired tolerance would again be lost, and treatment would again become effective. Personally, Dr. Gwyer said, he had not seen this acquired tolerance in any of the cases in which he had given the thymus. The gland seemed to have a selective action on the cancerous growth, and he knew of no other remedy or treatment which produced such a rapid and marked change in the clinical appearance of the lesions. A month ago some of the enlarged glands in the case he had shown were visible across the room; to-day they could scarcely be felt.

TUBERCULINS AND THE TUBERCULO-OPSONIC INDEX.

DR. THEODORE DUNHAM read a paper with the above title for which see page 596.

DR. ROGERS said he had employed this method of treatment to some extent in tubercular cases, and was very well satisfied with it. There was considerable difference of opinion in regard to the value of the opsonic index, and for a long time, Dr. Rogers said, he had shared in the feeling of scepticism regarding it. Since then, however, he had had practical evidence of its efficacy in a case of tuberculosis of the glands which had previously been operated on a number of times, and in which the glands rapidly disappeared under the use of tuberculin. There were many cases of tuberculosis of the glands and bones and joints and some of visceral tuberculosis which were perfectly hopeless from a surgical point of view, and it was in that class of cases that this treatment should be given a thorough test. The speaker said he had resorted to it in two cases of Pott's disease, with psoas abscesses and discharging sinuses, fever, etc. He began by giving these children a solution which was made by mixing 0.000001 gm. of ground tubercle bacilli (Koch's "TR") in 1 c.c. of sterile water. Of this mixture a dose of 1 minim was given on the first day, and increased 1 minim each day. The opsonic index was not taken, and the speaker said he did not think that was necessary. In these two cases the dose was gradually increased, and by the end of the second week the discharge from the sinuses had almost entirely ceased. A week later the children were up and running about the wards, and showed other signs of improvement, although the sinuses had not entirely closed.

It was very necessary in these cases, Dr. Rogers said, to keep track of the temperature, because with an elevation of the temperature the symptoms became aggravated and the discharge from the sinuses increased.

DR. BLAKE said it was well known that the treatment of pulmonary tuberculosis with tuberculin had been carried on for some time without the help of the opsonic index for the purpose of determining the proper dose, and very good clinical observers had made the assertion that it was not necessary to have the opsonic index in order to determine the amount of tuberculin to be given. He referred to a case of mixed tubercle and staphylococcus infection of the cervical lymph nodes where the tissues had become undermined with burrowing sinuses in which a thorough course of treatment with vaccines had had no effect whatsoever.

DR. DUNHAM said he had treated a number of tuberculous children with tuberculin in small doses without taking the opsonic index, and they had all done surprisingly well as regarded their general health. One was a rather bad case of tubercular peritonitis which had been operated on several times, and which afterwards did exceedingly well under the tuberculin treatment. He had also tried the method in cases of tuberculosis of the joints and in tubercular sinuses. He had become quite enthusiastic regarding the treatment, and had a strong feeling that it could be carried out almost as well without the opsonic index as with it. While the determination of the opsonic index was very desirable, the process was a laborious one, certainly in hospitals where a number of these cases were under treatment. In dealing with obscure cases, the recognition of tuberculosis by the opsonic index would be exceedingly useful.

AN INFLAMED APPENDIX REMOVED FROM A STRANGULATED INGUINAL HERNIA.

DR. LE BOUTILLIER showed a specimen, which he had removed from a twelve weeks' old baby who had a congenital right inguinal hernia which had become strangulated. The hernial sac was found to contain cæcum and an inflamed appendix which was about an inch and a half long.

The history of the case was that the hernia had been irreducible for about ten days. The hernial tumor was about the size of a walnut. The abdomen was distended and tender, and there was fever and vomiting. Three days before operation the attending physician had succeeded in reducing the hernia, but in spite of this the symptoms of vomiting and pain persisted. The hernia again descended about eight hours before the operation was done, and the scrotum was exceedingly red and tender. Recovery was uneventful.

BOOK REVIEWS.

SURGERY OF GENITO-URINARY ORGANS. By J. W. S. GOULEY, M.D., New York City. Rebman Company, New York, 1907.

After fifty years of surgical work, dealing with a class of patients in Bellevue Hospital in which urological disease is rampant, Dr. Gouley has gathered together in this volume the experience of these years. Dr. Gouley has written many papers upon various subjects but this is the first book which has been published by him. To the beginner in the study of the diseases of the genito-urinary organs, the book is of special value because it treats of the subject almost entirely from a clinical standpoint. The work consists of brief annotations on the nature, diagnosis and treatment of some of the diseases of the genito-urinary organs that come within the province of surgery. The book is by no means a systematic treatise on genito-urinary surgery; it treats simply of the surgical diseases of the urethra, prostate and bladder, and is practically a collection of the papers read and published by the author at various times during the course of his work. The book is delightful reading to one interested in this branch of surgical endeavor and it abounds in truths and practical suggestions, although the domain of the clinical pathologist has been sadly but purposely neglected. Those who are entering upon this work would do well to pause and read the conclusions of a surgeon of Dr. Gouley's vast experience.

PAUL PILCHER.

SURGICAL DISEASES OF THE CHEST. By CARL BECK. Philadelphia: P. Blakiston's Son & Co., 1907. ix, 371 pp. Illustrated 8vo.

A review of the book naturally falls into three portions:—

1. The Anatomy.
2. Those surgical conditions that occur in this region but also in other parts of the body.
3. The conditions that occur in the chest region exclusively and merit a special treatise.

The author devotes one-seventh of the book to anatomy. This part conforms to the standard text-books on anatomy and the illustrations are from Morris.

The second part takes up in a superficial way such diverse subjects as Hodgkins disease, spina bifida, kyphosis, fractures, carbuncles, burns, etc., and the ordinary details of the sterilization of the surgeon's hands. The author also considers subphrenic abscess and cervical rib, which are not strictly diseases of the chest.

In the third portion of the book, to which the surgeon naturally turns, the subject of pyothorax is treated at length. The author advises the use of his special periosteotome, rib shears and pleural speculum. After a subperiosteal resection of the rib and slow evacuation of the pus, he introduces the finger, or sponges on holders, or a blunt spoon through the pleural speculum into the pleural cavity to remove all fibrinous masses and irrigates with salt solution. He then stitches the costal pleura to the skin with four silk sutures and packs the cavity with several yards of a narrow strip of 3 per cent. iodoform gauze, dispensing with the use of rubber drainage tubes. Then follows an extensive argument to prove that his method is more satisfactory than those in general use, in the ordinary acute cases.

For chronic pyothorax he gives the history of the development of the more radical operations now employed to combat this condition. The other surgical intra-thoracic diseases he treats in brief.

The book closes with a consideration of the diseases of the mamma.

The X-ray illustrations are in part new and in part from the author's recent work on the "Roentgen Ray in Diagnosis."

WALTER C. WOOD.

CORRESPONDENCE.

FRACTURE—DISLOCATION HEAD OF HUMERUS.

TO THE EDITOR OF THE ANNALS OF SURGERY:

SIR:—It may interest your readers to know in reference to Dr. Keen's case—June, 1907, p. 945—of fracture of the anatomical neck of the humerus with dislocation of the head into the axilla, that in 1893 I recorded two cases in the Transactions of the Pathological Society of London, Vol. XLIV, p. 128.

The head in each case was removed from the axilla by operation—one by Mr. Croft and one by myself, and both specimens are now mounted in the Museum of St. Thomas's Hospital. The illustrations published in the Transactions are almost identical with that of Dr. Keen's published in the ANNALS OF SURGERY for June, 1907. In 1893 we had not the advantage of the X-rays, but there was not the slightest difficulty in recognizing the nature of the injury.

Yours faithfully,

July 26, 1907.

H. H. CLUTTON,
2 Portland Place, West,
London, England.

EDITORIAL NOTE.

POPLITEAL THROMBUS.

The figure on page 347 "showing thrombus in popliteal artery" should have been inserted on page 363.

TO CONTRIBUTORS AND SUBSCRIBERS.

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ORIGINAL MEMOIRS.

MULTIPLE CARCINOMATA FOLLOWING CHRONIC X-RAY DERMATITIS.*

BY CHARLES ALLEN PORTER, M.D.,

OF BOSTON, MASS.,

Surgeon to the Massachusetts General Hospital,

AND

CHARLES J. WHITE, M.D.,

Instructor in Dermatology at the Harvard Medical School.

THE recent death of Prof. Fuchs of Chicago from metastatic X-ray carcinoma leads me to report in detail the history and present condition of another case of multiple epithelial carcinomata which has been under my care since 1897.

In delaying this report until the present time I have been greatly influenced by my personal regard for the patient; but the above case, the fourth fatal one in the United States, and a slowly increasing list of undoubted instances of X-ray carcinoma, here and abroad, makes it imperative that the attention of dermatologists and surgeons should be thoroughly aroused to the great *danger of all persistent X-ray ulcerations* and especially to those which have followed, with a few years interval, the chronic skin lesions of the earliest operators.

The first published account of the injurious effects of the X-ray with which I am familiar, was a paper by Marcuse,

* Read by title at a meeting of the American Surgical Association held at Washington, May, 1907.

“Dermatitis und Alopecie nach Durchleuchtung mit Röntgenstrahlen” in the *Deutsche med. Wochenschrift*, No. 30, 1896.

From 1897 the literature of this subject has grown each year. The earlier articles dealt with the immediate effects of the X-rays, dermatitis and burns; then it soon became recognized that these lesions were most excruciatingly painful and extremely slow to heal; further experience showed that some lesions closed with great difficulty only to break down again and again, and finally formed chronic ulcers:—then came the first report of cancer developing in a chronic ulcer, and finally the first death from metastatic carcinoma.

In an excellent article written by Dr. Richard Mühsam, and published in the *Archiv für klinische Chirurgie*, 1904, No. 74, “Über Dermatitis der Hand nach Röntgenbestrahlung” may be found a full bibliography of the literature up to that time and a brief résumé of the histology of the characteristic lesions with which we are unfortunately too familiar.

CASES OF X-RAY CANCER.

I and II.—In 1903 Sick reported two cases, both in X-Ray operators, the first, after years of severe changes in the skin of the arms, neck and face, finally developed an ulcer upon the back of the hand, which soon took on the typical appearance of a carcinoma, and required amputation at the shoulder joint.

The second, with similar skin lesions of six years duration, also developed a chronic ulcer on the hand, which was excised and showed upon microscopic examination the typical picture of a skin canceroid, with cancer nodules in the cutis—the material from these cases was examined by Unna.

III.—Dr. Blacker of England, mentioned in *Medical Record*, Oct. 22, 1904, for a long time suffered from an X-ray burn of the hand which was neglected till the cancer which had developed had extended up the arm and involved the axillary glands, when it was too late for operation.

IV.—Clarence Daly. Personal communication from Dr. Samuel Lloyd of New York and Dr. W. B. Graves of East Orange, N. J.

This patient was very seriously burned on both hands years before, in working with X-Ray tubes. He was treated at many different hospitals. Skin grafting was tried without result, until finally epithelioma developed on the right hand and on the base of the little finger of the left hand. At the time of Dr. Lloyd's first examination the right hand was infiltrated with carcinoma and the axillary glands were involved.

The arm was amputated at the shoulder joint and the glands above and below the clavicle removed. Amputation of the left hand was advised but refused. This was August 8, 1902. The ulceration gradually increased in size and depth and the left arm was amputated by Dr. Graves on March 16, 1904. Death followed from mediastinal recurrence in October, 1904.

V.—Epithelioma of finger of X-ray machine manufacturer (communication from Dr. Lloyd).

VI.—Personal communication from Dr. W. B. Coley, Surgeon of Rochester, New York. For five years had been using X-Rays continuously. Ulcerations present for six months on the backs of both hands, specimens from which were examined by Dr. Welch and found to be undoubted epithelioma. Amputation of right hand above wrist and thorough excision of ulceration on left hand October 10, 1904. Subsequent recurrence in axilla and death.

VII.—Bertha Fleishman, San Francisco, death. Quotation from *New York Sun*, April 24, 1907.

VIII.—Foulterton's Case. *Lancet*, May 6, 1905. At a meeting of the Pathological Society of London, Foulterton reported the case of a surgeon who began systematic work with the X-rays in 1897. In May, 1903, had a severe attack of dermatitis, blistering of the skin on back of index and middle fingers of left hand, ulcers resulting healed in about four months. New skin was thin and tender and showed nevoid looking patchiæ. The nails fell out and new ones were hard and brittle. In December, a second attack of dermatitis again caused ulcers on first and second fingers. Ulcers on index finger remained open and in April, 1904, began to assume a malignant character. In September of that year, finger was amputated at the metacarpo-phalangeal joint. Sections of index finger showed typical squamous celled cancer.

IX.—Personal communication from Dr. L. L. McArthur of Chicago, dated April 26, 1907. Patient was the first photographer to develop X-ray plates in America. "He early developed the chapped and fissured hands which go with the exposure to the ray, *especially* in those who combined the development of their plates with their X-ray work. For the last three years he has been having, from time to time, minor surgical procedures in the way of removal of a phalanx now and then, until three fingers of the right hand and two on the left had been sacrificed. After various plans of local treatment and a trip to Europe in search of remedial agents, he came to me for the first time with an enormous axillary involvement. This was indubitably squamous celled carcinoma. The radical operation with removal of portions of the pectorales and a dissection of the axilla en bloc failed to effect an arrest of the trouble. Recurrence took place very promptly, and within three months again filled the axilla and involved the supraclavicular glands. Deeming it hopeless to subject him to further surgical interference, trypsin injections were given, with a resulting liquifaction of the axillary mass to a nonpurulent, sero-sanguinolent fluid containing immense masses of epithelial cellular detritus, as was shown on opening and draining the same.

After lingering for six weeks he finally succumbed to a multiple metastasis on April 23, 1907."

X.—"The second case was that of a physician who combined his electrical therapeutics from his static machine with the taking of pictures of his surgical cases. He, too, developed his own plates and constantly had his hands stained with the photographing solutions. He had the usual history of a chronic dermatitis with ulcerative processes that refused to heal, and required removal of the terminal phalanges on his left index and middle fingers. When he came to me it was with a typical epithelioma on the remains of the left index finger, and numerous senile keratoses on the back of both hands. I amputated the finger, which microscopic section demonstrated to be carcinomatous. I removed by a deep shaving-like cut the senile keratoses and grafted the same. I secured primary union in the grafts, had a mild infection along the stitch line in the amputation and an aseptic result in the axilla which I cleaned out radically though no glands were distinctly palpable at the time of the operation. No metastases were found in those lymph glands removed from the axilla which were examined. At present he is in good health."

From a careful search through the literature and some personal inquiry these ten cases of undoubted X-ray cancer are all which I have been able to find. I have purposely excluded a few recorded cases of carcinoma developing in lupus tissue after Röntgen treatment, and one or two cases of epithelioma, following burns, for I wish to limit the question under discussion to cancer resulting in the X-ray operators who for years have followed their work in spite of previous inflammations of the skin and persistent lesions.

If my case be included, there are eleven cases, of which five have proved fatal, and as one of Sick's, reported in 1903, had to submit to a shoulder joint amputation, it is probable that this result was also a fatality. The prognosis in X-ray cancer would therefore appear appalling if it were not for the very great likelihood that all fatal cases have been published while no record has been made of the much larger number of sufferers, who after excisions or minor amputations have as yet shown no evidence of recurrence. Though it is obvious that surgeons will very naturally hesitate, in the case of a brother physician, to add publicity to misfortune, there are so many unfortunates throughout the country, suffering from chronic lesions of all grades of severity, that it is now a duty

I think for all who have charge of these cases to publish their experiences in order that our knowledge of this difficult subject may be increased.

The case which I have to report is that of an X-ray operator, who, as a *young man*, first began X-ray work with a large static machine in March, 1896; after October of the same year a powerful twelve-inch coil was used. Exposure lasted for several hours each day, at a very *short distance* from a *low vacuum* tube. About the middle of November hands became red and dry, and in a few days very painful and greatly swollen. Under black-wash the dermatitis subsided, but the finger nails first became dry and striated, then softened and finally sloughed off (the patient felt convinced that this condition of the nails was greatly aggravated by the use of chromic acid in development of the X-ray plates). In spite of the fact that one per cent. orthoform ointment had to be used almost continuously to relieve the intense pain, work was continued until April 1, 1897, when the onset of another very severe dermatitis, with the formation of enormous blisters, and pain "beyond description," necessitated ward treatment for a month. White-wash gave considerable relief. All forms of treatment by ointments, powders, and washes, which Prof. J. C. White could suggest, proved useless; the chronic ulceration which now involved most of the backs of the fingers of both hands refused to heal. Orthoform ceased to relieve the pain. At the suggestion of the patient Reverdin grafts were applied on July 10, 1897, to the tip of the left forefinger, which presented the appearance of a sluggish ulcer, with rather exuberant granulations and unhealthy-looking edges. These pin-point grafts "took" and grew. Accordingly on August 13, 1897, under ether, all the ulcerated areas were cleaned up, shaved down to an apparently normal base, and Thiersch-grafted; fourteen different grafts being applied. Contrary to all expectations, the great majority of these grafts adhered and "*have never broken down since*, nor do they show the eczematous condition, which now exists on the areas not grafted." "Pain ceased absolutely from the time of operation, and areas then grafted are in good condition to-day." "Epithelioma has *never* developed in any graft which *completely* took at this time." (I quote from a letter which the patient wrote me in 1905.)

Though all X-ray work was stopped for a year ulcers developed upon the fingers, and again in spite of all treatment refused to heal until excision with skin-grafting was carried out; after several operations all the chronic lesions were successfully grafted or healed spontaneously, except some very persistent ulcers on the ends of the ring fingers of both hands and the little finger of the right hand, which in spite of six or seven operations refused to heal.

In July, 1902, the persistent ulcerations at the tip of the ring fingers were again excised and grafted. The grafts did not take. The specimens sent to the pathologist were misplaced and not until October, 1902, was the report received that both ulcerations showed unmistakable evidence of carcinoma. In the meantime these finger tips had become excessively sensitive and painful and showed an angry-looking ulcer, with somewhat raised and indurated edges. On or near October 31, 1902, both of the ring fingers were amputated at the knuckles.

- I. The ulcer on a ring finger is shown in Fig. 1.
- II. The gross appearance under a low power in Fig. 2.
- III. The microscopic picture in Fig. 3.

During the period from October, 1902, until June, 1905, a dozen or more operations under ether were performed—amputation of the middle finger of the left hand, removal of the tips of the second and third fingers of the right hand, and numerous excisions of keratotic areas or chronic ulcerations on the dorsum of the remaining fingers or backs of the hands. Figs. 4 and 5 show the conditions of the hands.

In June, 1905, for the first time in eight years, the patient was free from pain and no dressings had to be worn. Both hands could be placed in his trouser pockets. The left hand was soundly healed; the right showed one superficial ulceration at the base of the third finger, with considerable thickening of the skin about it and numerous other keratotic areas. Unfortunately during the summer the favorable condition did not endure, but steadily, though slowly, several places on both hands began to break down. Under date of November 8, 1905, the following notes were made: "For three months following a slight bruise and subsequent infection, there has been a great deal of pain in the tip of the stump of the little finger on the right hand; gradually an ulcer formed,

FIG. 1.



Ulcer at end of amputated ring finger, Oct., 1902.

FIG. 2.



Ring finger, 1902. Low power.

FIG. 3.



Ring finger, 1902. High power.

FIG. 4.



Condition of hand, June, 1905.

FIG. 5.



Condition of hand, June, 1905.

FIG. 6.



Ulcer at end of little finger, Nov., 1905.

FIG. 7.



Keratoses on back of hand. Carcinoma at base of middle finger. Nov., 1905.

about the size of an old-fashioned three-cent piece, which looks very angry and resembles those found in the ends of the fingers in 1902."

Figs. 6 and 7 show the condition. At operation the end of the little finger was removed and a suspicious ulceration at the base of the third finger thoroughly excised. The back of the forefinger over the second phalanx showed a superficial unhealthy-looking ulceration which involved the old graft; on the ulnar side of this finger were several macerated warts, which had been excessively sensitive and painful. On the radial side were numerous cracks and fissures, with some keratoses, but nothing suggesting anything malignant. All these lesions were excised, as were seven other places on the backs of the hands and Thiersch grafts were applied. All of these grafts took except those on the back of the forefinger, which sloughed and left exposed the white and glistening but not necrotic aponeurosis of the extensor tendon. Dr. Wright's examinations showed that the ulcer on the end of the little finger was not malignant, but that the specimen removed from the base of the third finger was a typical epithelioma. One or two others suggested beginning cancerous degeneration.

During the winter and spring of 1906 these areas broke down further, and the middle joint of the first finger, from sloughing of the extensor tendon became flexed and discharged synovial fluid. For a time there was some infection, but this soon passed away. During the summer the patient suffered much from this persistent ulceration. The back of the middle finger also began to break down.

In November, 1906, under ether, the ulceration and unhealthy granulations on the back of the first finger were again excised. Examination by Dr. Wright of frozen sections showed epithelioma, or at all events invading epithelium; accordingly the excision was extended into apparently sound tissue at the margins, and the base was removed down to the bone. The dorsum of the third finger was thoroughly scraped with the knife, the tip of the little finger of the left hand removed for persistent ulceration, and several suspicious areas excised. All open surfaces were grafted successfully except the backs of the second and third fingers. A subsequent report from Dr. Wright confirmed his diagnosis of superficial epithelioma in the tissues

removed from the back of the forefinger; the ulceration on the third finger was negative.

By January 1, 1907, there was some evidence of healing from the edges in both ulcerations. The patient wished very much to delay radical treatment of the first finger, for as the third finger was stiff, amputation meant almost total disability of the right hand.

The condition of the hands on April 25, 1907, is shown in Figs. 8 and 9—*the result of ten years of treatment and twenty-five operations under ether.*

On the left hand the thumb is sound and serviceable. The forefinger is stiff, but shows no lesions. The third and fourth fingers have been amputated. The little finger lacks a terminal phalanx. On the back of the hand there are a few keratoses, but no ulcerations. *On the right hand* the thumb is useful, but at its base is a small ulceration, and the whole ulnar side is covered with thickened epithelium. The forefinger is flexed and presents an ulceration over its middle which is undoubtedly malignant. (This finger will be amputated in June.) The middle finger is stiff. There are a few sluggish granulating areas on the dorsum, but these are healing in. The fourth finger is lacking, as is also the end of the fifth. There are numerous keratoses, but no other ulcerations on the back of the hand.

The palmar surface of both hands is normal. The skin grafts, which are outlined in black, are soft, movable, and some of the thicker ones have almost the appearance of normal skin.

The axillary glands have been somewhat enlarged for many years, but show no evidence of increase in size.

From the first demonstration of epithelial cancer in 1902 on the tips of the fourth fingers, undoubted malignant degeneration has been found in eight other areas, so that we have the extraordinary development of ten different epitheliomas in one case in five years. As the report by Dr. White will show, from such a condition there are all grades of what might be termed precancerous changes, down to simple ulceration or benign keratosis. In this as in the other reported cases, persistent ulceration has for a time, from three to six months, always preceded cancer.

FIG. 8.



Condition of hand, April, 1907.

FIG. 9.



Condition of hand, April, 1907.

FIG. 10.



Hand of G., May, 1907.

FIG. 11.



Hand of G., April, 1907.

In addition I will report a second case of chronic but much less severe dermatitis to show the advantage of skin grafting for recurring fissures; and the report of Dr. Mallory upon the recurrent growth which may prove to be a sarcoma.

Mr. J. G., X-ray operator, has suffered for many years with the milder varieties of X-ray lesions such as atrophy of the sweat glands, more or less persistent eczema, marked atrophy and longitudinal ribbing of the finger nails, with the characteristic X-ray telangiectases and keratoses. During the winter most painful fissures occurred over the extensor surfaces of the joints. It is of interest to note that none of these lesions are present over the proximal phalanx of the ring finger, which was protected from all early exposures by a broad gold ring.

In May, 1906, the keratoses and fissures on the back of the right hand were excised and grafted. Fig. 10 shows condition ten days after the operation. All of the grafts took. These were prominent and raised above the surface for a month, but at the end of that time were level with the surrounding skin and remained solid until September 15, when a spot on the terminal phalanx of the ring finger became ulcerated. Under gas and ether on October 18 this ulceration was freely excised and the radial fourth of the nail with its matrix extirpated. The skin at the margin of the nail was approximated with plaster and another graft was applied. In ten days the wound was completely healed and free from pain. This finger remained painless and healed until the middle of March, 1907, when the distal part of the graft on the radial side began to increase in size and show well-marked vascularity. After two weeks there was a slight discharge near the edge of the nail.

Examination by Dr. Wright of this specimen led him to make a diagnosis of spindle-celled sarcoma, though by some the growth was thought to be a granuloma.

By April 23, 1907, the growth had become decidedly larger and was apparently extending backward into the proximal graft. See figure 11. After careful consideration of the possibility of the return of the growth excised in October, but chiefly influenced by the anatomical conditions, which could not, in all probability, be rectified by removal of the nail and grafting, the

terminal joint was amputated under gas and ether. The wound was completely healed in a week.

Examination of tissue from finger of J. G. following exposure to X-rays by Prof. Mallory, of Harvard Medical School.

The section shows an oval, cellular mass of tissue partially surrounded by more or less normal fibrous tissue. The cellular mass at its outer end is ulcerated and covered with fibrin, cells and dried necrotic tissue. The more normal tissue is covered with epidermis. The oval, cellular mass of tissue is quite sharply defined and is limited by a layer of dense, fibrous tissue. It is composed of rapidly growing connective tissue cells and of a small number of thin-walled blood vessels. The connective tissue cells are typical, that is, they have flat, oval nuclei and contain one to three coarse chromatin masses. The cytoplasm is made out with difficulty. In places the cells are bordered by very delicate fibroglia fibrils. Everywhere the cells are separated from each other by a relatively large amount of ordinary (collagenous) fibrils. The cells and their fibrils tend to form small bundles which run in all directions. Mitotic figures are numerous, one to three showing in nearly every oil immersion field. While the cellular mass of tissue at its base is sharply defined, on both sides, it gradually blends with the adjoining connective tissue.

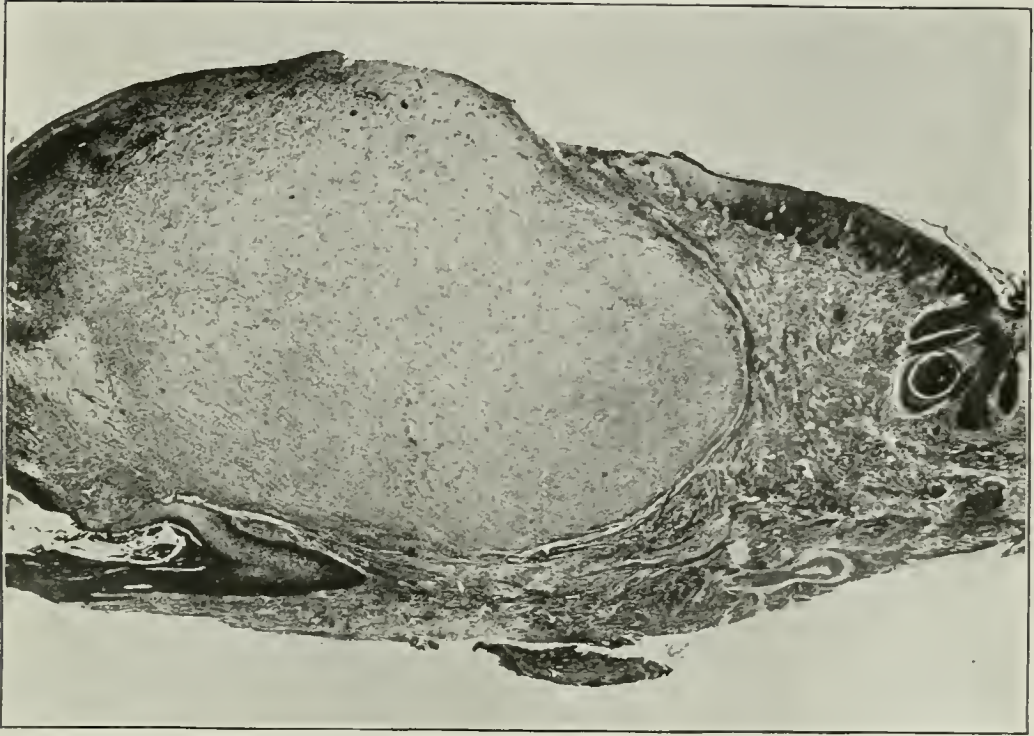
The adjoining tissue of the finger shows infiltration with numerous groups of lymphocytes. Otherwise there appears to be no change in it. It is difficult to give a positive diagnosis in this case. The rapidly growing mass of connective tissue may be either an unusual form of reparative action on the part of connective tissue or it may be a connective tissue new growth, namely, a rather slow growing spindle-cell sarcoma. Personally I favor the former view owing to the lack of any definite evidence as yet of invasion.

F. B. MALLORY.

The microscopical appearances under the low and high power are shown in Figs. 12 and 13. Note beginning epithelial infiltration at the extreme right of the photograph.

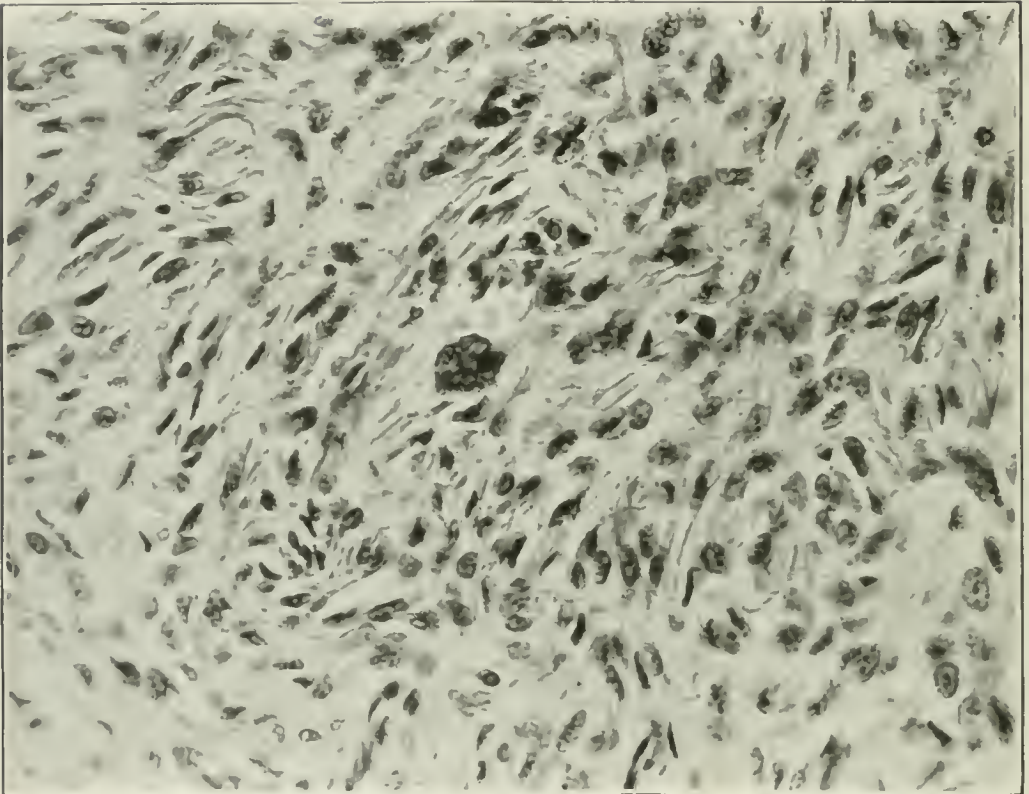
During my long experience with the first case I have learned many things about skin grafting, and now have no hesitation in recommending it, as the best treatment for all chronic X-ray lesions. Early in the history of this case, the tissues were remarkably vascular. There frequently occurred little hemorrhages in the skin, which were often the starting-point of subsequent ulceration; there appeared to be an almost complete vaso-motor paralysis. Owing to the chronic eczema no adequate disinfection was possible so that most of the early

FIG. 12.



Tissue from hand of G. Low power. April, 1907.

FIG. 13.



Same as Fig. 12. High power.

operations were somewhat influenced by sepsis, yet in spite of this the grafts often took surprisingly well. Hæmorrhage proved to be most troublesome, not only at the time of operation, but subsequently, when blebs would form under the grafts, and unless speedily snipped with scissors would detach them. Hæmorrhagic infiltration of the grafts was often noticed on the second or third day, doubling their thickness.

As a rule I applied a finger tourniquet before excising, as much of the work had to be done with great care, especially when dealing with a suspicious ulceration over an aponeurosis or tendon sheath. Fortunately, no deep infiltrations have yet occurred. After excision firm pressure by gauze was applied to the raw surfaces for ten minutes, and the hands were then exposed to the air and held aloft. No grafts should be applied until all bleeding has ceased. So far as possible an attempt should be made to bevel the edges of the wound. After shaving off granulations to get a smooth surface, the base of the wound is next examined for vascularity, in order to determine the thickness of the graft which should be used. While the ultimate result, if successful, which a thick graft gives, is most desirable, I feel sure that I have occasionally jeopardized healing by attempting to place a thick graft upon a very small spot, or upon such bloodless tissues as the backs of the fingers. I now use thinner grafts. If these fail, another operation should be done when the surface has become covered with granulations. A very small spot upon the fingers is most difficult to graft. I have had the best results by cutting a special graft for each place, thickest in the middle and gradually thinning towards the periphery, in order that it may fit evenly into the concavity of the wound. When possible, the whole forearm was firmly fixed with adhesive plaster to a well padded palmar splint before any of the grafts were applied. More than once from a sudden movement of the patient or an assistant, many of the grafts have been brushed off. The patient should be kept under full surgical anesthesia until the dressing is completed.

After having tried all the methods of dressing the

grafts with which I am familiar, I have adopted the following technique, and after-treatment. The grafts are so cut and arranged that they *do not overlap* either the edges of the wound or each other. If on the back of the hand, they are covered with a piece of rubber protective tissue which extends not more than $\frac{1}{8}$ of an inch beyond their edge; if on the fingers, narrow strips of protective, arranged in an imbricated fashion, encircle $\frac{2}{3}$ of the finger, and are stuck in position with blood, which soon coagulates. A small absorbent gauze pad is then placed over the protective and then *direct downward* pressure is applied by a piece of gauze or bandage, which is tied with a surgeon's knot on the palmar side of the splint. I was forced to resort to this manœuvre by the discovery that the smaller grafts now and then were carried from left to right by the ordinary application of the bandage. Owing to the amount of exudation which occurs immediately after the operation, I have found it unwise to adopt immediate exposure to the air, as is now customary in *normal* skin-grafting. After twenty-four hours, with the hand continuously elevated, the protective is carefully removed. Longer delay in this case has almost always been followed by maceration of the grafts.

At the first dressing, blebs, if present, are snipped with the scissors and their contents gently expressed. Any lateral movement of the graft must be avoided. All the *edges* of the individual grafts are then greased with lanolin, or with the following ointment which was found to be less macerating.

Benzoinated lard.....	175
Lanolin	25
Ichthyol	4
Silver citrate.....	1

The grafts were then covered with a cage and allowed to dry, exposed to the air, and so treated for the next week whenever possible. Often, however, the sensitiveness and pain after half an hour's exposure were so great that the whole surface had to be covered with the ointment.

Almost without exception the pain in these ulcerated areas as well as in the X-ray burns which I have excised, has ceased from the time of operation. It is interesting to note that in one instance thick grafts grew even on the base of an epitheliomatous ulcer, but within three weeks became excessively hypertrophic. After subsequent amputation of the finger, sections showed carcinoma invading the bottom of the œdematous graft.

Though future events may prove that my treatment of this patient has been too conservative, his present condition would seem to justify it.

In order that the abundance of material which has resulted from all these operations may prove of value to dermatologists, interested in the study of the pathological conditions induced by the X-rays, Dr. C. J. White has kindly made a careful examination of all the slides which have been preserved, and his exhaustive report forms a most valuable addition to my paper.

The clinical appearances of the chronic X-ray dermatoses, suggest a precocious and extreme senility of the skin; microscopic examination, also, shows the most extraordinary changes, always of a degenerative character, unequalled in their severity and chronicity by the effects of any other agent.

In view of these facts and the histories of the eleven cases reported, I think the following conclusions are justified:

1. For the atrophic condition of the skin and the telangiectases nothing can be done.

2. Hypertrophic changes, keratoses and warts may with safety be treated in the usual manner. If such treatment fails, excision with or without skin grafting, will probably relieve the pain and result in a cure.

3. Excision and grafting will prove to be the best treatment for recurrent fissures.

4. All ulcerations, which, under ordinary treatment, remain open, after three months, should be thoroughly excised, and very carefully examined. The subsequent treatment de-

pending upon the result of the microscopic examination, should be skin grafting; further excision and grafting, or amputation.

5. As the history of almost all of these cases of severe and chronic dermatitis dates back to early exposures, with the protection which our present knowledge demands, it is to be hoped that the number of victims of too enthusiastic work in an untried field, will steadily diminish.

6. In the meantime, I have no hesitation in recommending the *early excision* of all *persistent X-ray ulcerations*, in order that subsequent malignant degeneration may be prevented.

PATHOLOGICAL REPORT.

BY CHARLES J. WHITE, M.D.,

Instructor in Dermatology in Harvard University.

The pathological report which follows is based upon the study of forty-three microscopic slides presented by Dr. Porter. The sections were already stained, for the most part by the hæmatoxylin-eosin, iron-hæmatoxylin and methylin blue-eosin methods. It is to be regretted that no fresh material was at hand for the special staining of connective tissue and elastic fibrils. The first sections date from July 17, 1902, and were as follows:

1. *Finger of Right Hand.*—Keratosis moderate. Rete somewhat hypertrophic and shows an increased tendency toward downward proliferation. Corium normal and presents no marked signs of inflammation. The deeper horizontal vessels, however, exhibit serious changes. In places veins appear displaying extraordinary mural thickening. No interior alterations are present beyond a slight enlargement of the cells but the outer coats are greatly hypertrophied. Here and there arteries are totally obliterated by endothelial overgrowth.

2. *An Ulcerated Area.*—The rete, where existent, is totally abnormal. The stratum corneum consists of a few lamellæ of non-nucleated cells. The stratum granulosum is absent. The stratum spinosum is made up of greatly dilated cells, the extra-nuclear protoplasm being much rarified and the nuclei shrunken, murally placed, or entirely gone. The palisade layer, however, shows comparatively normal elements. Here and there are masses of red blood cells, suggesting golden pigment granules and filling the whole depth of the rete.

As the ulcer is approached the spinous cells show more distinct

configuration but are horizontally elongated and interspersed with erythrocytes.

Corium.—Below this abnormal epidermis there are occasional masses of plasma cells accompanied by a rare mast cell. The papillary and sub-papillary vessels are dilated and many are clogged with red cells. Larger deeper vessels are choked with endarterial masses of nucleated cells. This condition is extraordinarily abundant—the lumen of some vessels of great size being entirely obliterated.

Invading the entire corium are polymorphous masses of epithelial cells ranging from small strings to great clumps with many smaller epithelial pearls. The epitheliomatous masses are outlined by a limiting band of deeply staining cells. Within these peripheral bands the cells are often oval and greatly enlarged with correspondingly hypertrophic nuclei containing one or two nucleoli. Some of the cells are really enormous (fusion?) while around them appear epithelial cells whose limiting membranes are indistinct and whose nuclei have disappeared. The epithelial pearls are large, some of them consisting of a nucleated centre surrounded by 15 to 20 concentric hyaline rings.

Mitoses are rare and between these epithelial masses are numerous cells.

3. *From a Finger.*—For the most part the epidermis is normal although the rete is somewhat hyperplastic. In one place, percontra, the spinous layer has receded to three or four layers of somewhat amorphous cells illy defined from the underlying corium and exhibiting deeper proliferation suggestive of epithelioma while above a nucleated crust appears.

The corium shows in the middle and lower layers a few highly dilated lymph spaces and some moderately enlarged blood vessels surrounded by dense plasmomata with an occasional mast cell; while still deeper are seen blood vessels presenting an obliterating endothelial change, and again others with persistent but distorted lumen and thickened walls surrounded by dense envelopes of connective tissue.

4. *From a Finger.*—Within the lobules of epithelioma are many large oval and round, swollen, pale-staining cells—some of great size. The progressive steps towards the formation of pearls can be demonstrated easily. Again mitoses are rare.

5. *Finger of Left Hand* (see photograph 3).—*Rete.*—Where the epidermis is intact there is a marked parakeratosis and acanthosis. The horny layer is decidedly thickened and nuclei persist; the stratum granulosum is absent; the upper layers of spinous cells are flattened and elongated and more or less devoid of nuclei and the whole rete somewhat hyperplastic. In several places the epidermic origin of the epithelioma is plainly manifest and broad masses of tumor cells are seen in direct continuation with the overlying rete.

Throughout the depth of the corium are seen lobules and whorls of epitheliomatous cells between which the collagenous bundles form a delicate meshwork in which are lodged masses of mononuclear cells—for the most part plasma cells—and very numerous, small, dilated vessels. Before any degenerative alterations have developed the cells of the outer

layers of the lobules retain their prickles undiminished. With the onset of degeneration, however, we note a disappearance of these spongioplastic prolongations and a concentric arrangement of the cells. Within these onion-like lamellæ the cells assume a roundish configuration with occasional great perinuclear halos while in the centre of the mass appears a basic-staining substance reminiscent of keratin. These conditions well illustrate the epidermic derivation of the tumor masses by their analogy to the progressive cornification of the normal epidermis.

In other parts of the section the epidermis shows less keratosis while the rete produces long finger-like projections into the corium. Finally, in still other areas, there is ulceration. The lowermost layers of the rete alone persist as round or oval, swollen cells; while again all signs of the epidermis are wanting and the surface is formed by a highly cellular corium.

The vessels are everywhere dilated. The papillary and subpapillary channels are delicately widened and the interlobular passages show the same condition while in the non-epitheliomatous parts of the section the deep vessels are very conspicuous and here and there form great reservoirs like those seen in cavernous angiomata. These veins do not exhibit dilatation simply, for their walls are manifestly hypertrophic.

Curiously enough, pigmentation, which we associate so strongly clinically with X-ray dermatoses, seems to play no rôle throughout all these sections and hæmatin or melanin granules are conspicuously absent.

6. *Ulcer: Tip of Third Finger of Right Hand.*—This area presents a central ulceration with comparatively normal epidermis on each side. The floor of the ulcer is composed of string-like serpentine masses of epithelioid cells, groups of erythrocytes, polynuclear leucocytes and rather inconspicuous bundles of collagen. Lower down the field becomes less troubled. The pus cells and red corpuscles disappear. The epithelioid masses grow less numerous while mononuclear elements and connective tissue cells replace them. The epithelioid elements for the most part form worm-like processes; but in places this configuration is lost, branches develop or irregular masses are produced. These figures are composed of cells exhibiting large, oval or round nuclei which contain many nucleoli and are surrounded by meagre protoplasm with no retaining envelop. Here and there are especially large cells which seem to be pushing their way through lymph spaces.

7. *From a Finger.*—Here the epitheliomatous process is young. The epidermis shows a loss of the stratum corneum. The granular layer is practically wanting save for an occasional attenuated cell with but few granules. The upper layers of the rete are elongated and more or less devoid of nuclei. The germinal cells on the other hand are conspicuously numerous, absorb the stains deeply but show an irregular demarcation from the subjacent corium and exhibit occasional downward buds.

The corium presents dilated subpapillary vessels with hypertrophied endothelial cells while the deep veins are enormously enlarged with frequent great thickening of their several coats. In the sub-papillary layer there are striking masses of plasma cells with infrequent mast cells

FIG. 14.



Section from periphery of ulcer on back of right wrist, December, 1903.

FIG. 15.



Section from base of ulcer on back of right wrist, December, 1903.

especially about the vessels. Here again can be seen delicate string-like masses of epithelioid cells which wind through the lymph spaces. Where these masses widen out their component cells display large swollen nuclei. Evidences of chromatophores or of free pigment granules are once more wanting.

Where epitheliomatous changes are absent the connective tissue nuclei are appreciably elongated and enlarged.

Thus far these sections date from the operations of July 17, 1902.

Back of right wrist December 23, 1903 (Fig. 14). The epidermic structures are normal with the exception of a slight tendency toward irregularity where the palisade layer and corium meet and here certain nuclei are surrounded by clear spaces while others have dropped out and are replaced by inflammatory cells.

The papillary vessels are dilated with hypertrophied endothelium. The corium is very dense and is filled with mononuclear cells not particularly grouped but generally distributed.

At the periphery of the section, however, where the section ends abruptly through ulceration (?) there are two lobules of epithelial cells. One suggests the epidermis irregularly cut (cross section?), the other contains œdematous cells, some without nuclei, others swollen with large vesicular nuclei, others containing granules of keratohyalin—in fact the whole picture is strongly reminiscent of the epidermic changes seen in *molluscum contagiosum*. The whole structure is surrounded by inflammatory tissue.

8. *Back of Right Wrist*. (December 23, 1903, Fig. 15.)—To one side of the ulcerated area shown in the photograph the epidermis is greatly modified. The palisade layer forms a straight but broken line owing to the disappearance of the papillæ. The cell nuclei are round or oval rather than elongated, show one or more sharply staining nuclei and are filled with chromatin granules. The intercellular spaces are irregular and often enlarged. The overlying layers of the rete are thickened and present swollen, œdematous, loosely opposed cells mostly free of nuclei and spines. The granular layer is represented by free kerato hyalin granules only, all other evidences of granular cells having disappeared. Lastly, the stratum corneum is composed of many dense lamellæ with numerous persistent nuclei. Thus the whole epidermis presents acanthosis and parakeratosis of pure type.

In the corium the absence of papillæ has already been alluded to while the subpapillary vessels are widely dilated and exhibit hypertrophic endothelial cells. Below, the collagen is comparatively normal save for occasional swollen bundles. Moderately numerous plasma cells and rare mast cells are present, sometimes grouped about a distended vessel. Finally, deep down in the corium appear prominent veins now enothelially now totally thickened.

The ulcerated portion (Fig. 15) presents a complex picture of masses of polynuclear leucocytes and red cells lying in a mediumly coarse reticulation with interspersed large dilated vessels filled with erythrocytes and coagulated fibrin and with occasional processes of epithelial cells with

grossly vesicular nuclei growing in from the sides or persisting as remnants. Below these abnormal elements lies a floor of thickened, rather anuclear collagenous bundles.

9. *Base of First Finger of Right Hand.* (December 23, 1903, Fig. 16.)—This represents scar tissue of considerable thinness. The epidermis consists for the most part of parallel bands of dense nucleated corneous lamellæ with occasional layers of rather amorphous, homogeneous, quasi rete cells containing infrequent round or oval nuclei surrounded by empty spaces. The germinal layer is represented by horizontally lying cells with flattened nuclei.

Even here the epidermis shows an effort toward downward proliferation foretelling future epitheliomatous growth.

The corium shows an absence of papillæ. The subpapillary layer is not as compact as one would suppose and its meshes are strewn with plasma cells, as seen in the photograph (16). There are frequent epitheliomatous cell nests, some solid and normal, others presenting varying degrees of central degeneration. In one (lying nearly centrally in the illustration) there is an outer ring of fair-sized, numerous, darkly-staining nuclei separated by a clear zone (artefact?) from the inner lamellated, flatly-nucleated layers which in their turn envelop an almost homogeneously degenerated centre containing an occasional giant nucleus and scattered nuclear debris and two large cysts partly filled with granulated protoplasm and mononuclear leucocytes.

The base is composed of practically normal fibrous tissue and the deep vessels when present exhibit no marked changes.

10. *Middle Finger of Left Hand.* (December 23, 1903.)—The tissue here is composed of a dense mass of fibrous elements devoid of all epithelial structures and free from vessels. It consists of practically structureless collagen on which lie small, round, solid-staining nuclei, the exact nature of which it is difficult to discern. In the deeper portion of the section the fibrous bundles form a reticulated mesh devoid of nuclei. The whole picture presents an extraordinarily blank mass.

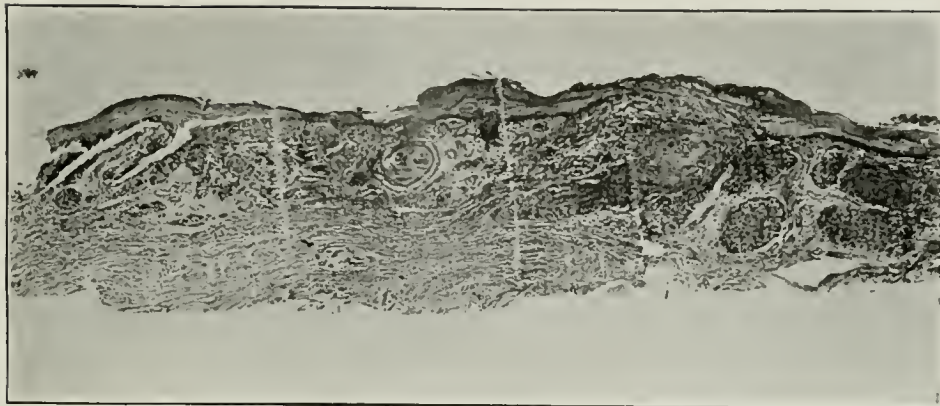
11. *Base of Third Finger of Right Hand.* (December 23, 1903, Fig. 17.)—The photomicrograph, 17, illustrates well the conditions present.

To one side an ulcerated surface of thickened collagenous material supporting numerous, many sized, mononucleated cells and small and large interstices containing erythrocytes with occasional whorls of œdematous and degenerated epithelial cells.

Where the epidermic covering is present the various layers are much altered. The rete shows an irregular base with marked tendency toward downward proliferation. The upper strata are emphatically hypertrophied while their component cells have lost their prickles and tend to coalesce, so that cell boundaries are gone, nuclei are swollen or absent and protoplasm is cloudy. The granular layer is represented for the most part by free kerato-hyalin granules. The stratum corneum is hyperplastic and nucleated. Again a marked picture of acanthosis and parakeratosis. Pigment is conspicuous by its absence.

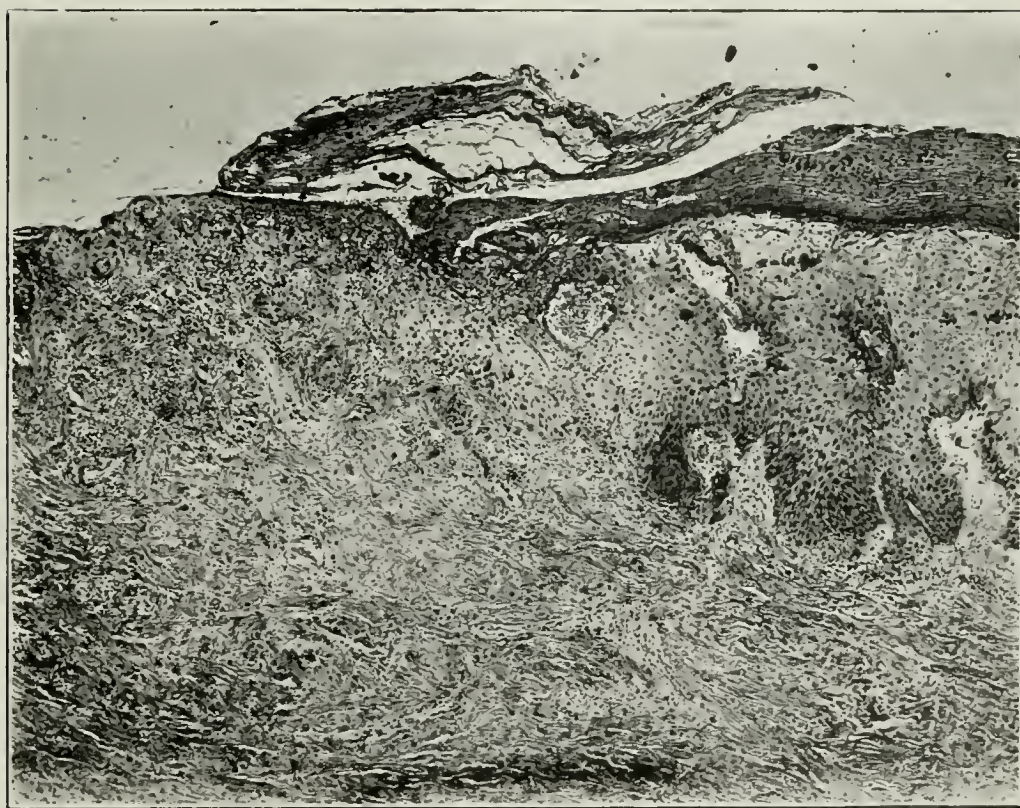
The corium exhibits only occasional papillæ which are filled with

FIG. 16.



Section from scar at base of first finger of right hand, December, 1903.

FIG. 17.



Section from tissue at base of third finger of right hand.

highly dilated vessels. The skeleton of the skin is composed of dense, rather anuclear bundles. Deeper vessels when present, show considerable thickening of their walls and constriction of their lumen and are surrounded by plasma and other mononuclear cells.

12. *Base of Little Finger of Left Hand.* (December 23, 1903.)—The process represented here is one of hyperkeratosis. The corium is dense. Vessels are slightly dilated and encompassed by extravasated mononucleated cells. Papillæ are insignificant. The rete is somewhat thickened for this part of the body but otherwise normal. The granular layer is manifestly hyperplastic and consists of five to six rows of large swollen cells with somewhat blunted ends and filled with masses of kerato-hyalin granules. The stratum lucidum is suggested but shows no traces of eleidin. The stratum corneum is conspicuously thickened and composed of layer upon layer of waving horny cells.

13. *Tip of Middle Finger.* (September 19, 1904.)—A very complex and irregular picture. The epidermis is mostly gone, the few surviving vestiges being quite atypical. The corium is totally abnormal and it is difficult to orientate oneself.

The upper layers are filled with dense masses of plasma cells and with sparsely scattered lymphocytes. Small dilated vessels with extraordinarily vesicular nuclei abound choked with red cells and occasional lymphocytes. The supporting fibrous tissue is in places dense, in others delicately reticulated, the intensity of the plasmomata corresponding directly with the density of the collagen. Here and there are small lobules of epithelial cells, occasionally whorls and more rarely branching tubules. All three forms exhibit absence of prickles and presence of highly vesicular cells containing one or two nucleoli and dense chromatin granules. The whorls and the tubules show a tendency toward central hyalin degeneration. When visible through comparative freedom from inflammatory invasions, the fibrous tissue shows a moderate proliferation of its nuclei.

14. *Base of Middle Finger.* (September 19, 1904.)—Great hyperplasia of the rete is the distinguishing feature here. For the most part the change is purely one of overgrowth in the depth of the layer. The cells are normal although somewhat œdematous and there is marked intercellular invasion of leucocytes. Here and there, however, the cellular elements show loss of prickles, vacuolization and tendency towards homogeneity. The stratum granulosum is represented mostly by free lying kerato-hyalin granules with occasional areas of partly developed granular cells. The horny layer is compact but otherwise normal.

The dividing line between epidermis and corium is so indefinite owing to the great overgrowth of the rete and the irregularity of the cut that it is difficult to ascertain the presence or absence of papillæ. There are numerous foci of snared-off epithelial clusters. The corium is dense and interspersed with numerous plasma cells, especially in the subpapillary layer.

15. *Keratosis from Dorsal Base of Middle Finger of Right Hand.*—This region presents an epidermic picture somewhat similar to the last

but here one finds the additional presence of a hyperplastic horny layer containing some nuclear cells. Again, the demarcation between corium and epidermis is well marked and the palisade layer more normal. Papillæ are present and hold dilated vessels—in one instance the whole papillary space is occupied by a vessel whose wide lumen is partially filled with lymphocytes, polynuclear leucocytes, erythrocytes and granular or reticulated fibrin. The corium presents the condition so frequently described in these sections, *i.e.*, dense collagen with dilated vessels and extravasated mononuclear cells.

16. *Tip of Little Finger.* (September 19, 1904.)—Another picture of parakeratosis and acanthosis with absence of papillæ and dense infiltrated corium.

17. *Ulcer on Back of Left Hand.* (October 16, 1904.)—A complicated structure. The epidermis is entirely gone and the corium contains many polymorphous epithelial lobules and whorls; superficial dilated vessels blocked with red and with white cells; and innumerable endothelial and mono- and polynuclear elements. The epithelial whorls and lobules consist in the majority of instances of spine-bearing cells and present all stages of degeneration even to cystic spaces containing chromatin granules and reticulated or granular protoplasmatic debris.

The underlying corium is composed of dense fibres with elongated and enlarged nuclei and the deeper vessels are murally thickened.

18. *Keratosis of Right Wrist.* (October 16, 1904.)—Once more conditions now so familiar in this series of sections. Here one finds a hyperplastic rete whose upper layers are oedematous and degenerated; a total absence of granular cells and even independent granules; and an enormously overgrown horny layer bearing nucleated scales and leucocytic crusts.

Papillæ are insignificant. Subpapillary vessels slightly dilated. Collagen delicate in structure and supporting some mononuclear extravasated cells.

Sections from five other excised portions of this same date show pictures presenting the various characteristics which have marked those previously described and need not be detailed again.

19. *Graft Upon Middle Finger of Left Hand.* (October 16, 1904.)—The artificial epidermic covering is to all intents and purposes normal, but in one portion of the section the insidious process has redeveloped and below the rete one finds the now familiar epithelial lobules with central hyaline degeneration.

20. *Keratosis from Forehead.* (December 27, 1904.)—A newly invaded field. This section illustrates almost perfectly the epidermic characteristics of the sole of the normal foot. The rete is somewhat thickened, the cells of the upper transitional layers more or less vesicular and thrown up into jagged summits and depressions into which dovetail layer upon layer of normal horny cells. The corium, however, shows evidences of considerable inflammation. Vessels are dilated and plasmomata are frequent. Sweat and sebaceous glands hitherto not observed in these sections are present in great abundance and exhibit no marked deviation from the normal.

21. *Forehead.* (April 20, 1905.)—The intervening five months have wrought a great change. In the present section ulceration has occurred and at the epithelial edge the cells of the upper layers of the rete are flattened and contain peri-nuclear halos or empty nuclear spaces; all semblance of granular cells has vanished; and a thin, parakeratotic horny layer is present. The lower layers of the rete are running riot. They have overcome the normal resistance of the corium and are proliferating enormously into the subjacent structures. Individual cells are often of enormous size and have become amorphous, anuclear swollen masses of protoplasm. In other areas large vesicular nuclei are present with but scant surrounding protoplasm. Cellular invasion is absent.

Farther down in the corium hugely swollen, anuclear bundles of collagen and some veins of extraordinary thickness and jagged, slit-like lumen appear. These unusual collagenous fibres would suggest an incipient colloid degeneration. The sweat glands remain strangely unaffected in the midst of these contiguous pathological structures.

22. *Hand.* (November 8, 1905.)—These sections are cut largely in so horizontal a plane that it would be injudicious to judge of the epithelial changes. There is, nevertheless, marked hyperplasia of the rete with occasional loss of nuclei especially in the germinate zone, general cloudiness of the cells and some intercellular leucocytic invasion. In places all vestiges of normal metamorphosis from rete to horn cells have gone and the free surface of the skin forms a chaotic mass.

The subpapillary layers, which alone are present, show fine reticulation supporting normal vessels and a general plasmomatic infiltration.

23. *Keratosis from the Hand.* (November 8, 1905.)—Here one has an ideal representation of a papillary and verrucous nævus. The rete is cast in individual rounded lobes formed by the fine and widely separated ascending papillæ and in places these lobes strongly suggest the lower rete conformation of molluscum contagiosum. In these lobes the rete is hyperplastic and fairly normal although perinuclear halos are common. The granular cells also exist in great numbers and one can count ten to twelve perfectly developed layers while above, before keratinization has been completed, as many more layers, half granular, half keratinous, appear. Above these increased strata lie row upon row of typical horn cells. Thus far the description has related to the interpapillary lobes but as is the rule in nævous pictures the rete and granular layers surmounting the papillæ do not present these hyperplasias but appear in comparatively normal amounts.

The papillæ are proportionately narrow but project far into the epidermis, in some instances to extraordinary distances. As is customary in this class of nævi the papillary and subpapillary vessels are slightly dilated and accompanied by a moderate number of mononucleated cells which lie between and under the epidermic lobes. The rete is practically normal.

24. *Ulnar Side of Forefinger.* (November 8, 1905.)—A mild degree of the preceding process, partly purely keratotic and partly slightly papillomatous.

25. *Ulceration of Finger.* (November 8, 1905.)—An intensely interesting picture of multiform and generalized degeneration which has affected practically all the various structures of the skin.

The epidermis is represented by remnants of previous downshoots from the rete which persist as barely recognizable, swollen, amorphous, acid staining protoplasm with occasional vesicular nuclei.

The papillæ of the corium are gone and the subpapillary layer holds numerous moderately dilated vessels within frequent, cloudy vesicular endothelial cells and with swollen lymphocytes, a few pus cells and reticulated fibrin in their channels. Collagen appears as straight, oedematous bundles between which extend chains of oblong plasma cells and more irregularly distributed lymphocytes. These plasma cells are histologically noteworthy for one seldom sees such well defined examples with their eccentrically placed, round nuclei bearing symmetrically arranged peripheral nucleoli.

These rows of alternating plasma cells and swollen collagen are interrupted by frequent vessels whose walls are cloudy and whose nuclei are vesicular and often of great size. Below, there are isolated or grouped masses of wavy or serpentine basic-staining elastic fibres (elacin) which lie between the fibrous bundles or form large, solid areas free from collagen.

26. *Outer Side of Forefinger.* (November 8, 1905.)—Another ulcerated surface disclosing many of the attributes of the previous section but not containing so many interesting histological features.

27. *Back of Right Hand.* (March 16, 1906.)—In this section there are stretches of epidermis and of ulceration. Where the former is present there is some tendency toward hyperplasia of the rete while the stratum granulosum is absent and the stratum corneum is represented by a thin homogeneous mass. Underneath, the corium is normal except for universally dilated vessels surrounded by plasmomata.

Where the epidermis is gone the corium is filled with circular or polymorphous lobules of epithelial cells which show no tendency toward degeneration. Multiple dilated vessels with lumens choked with red cells lie between these epitheliomatous masses and scattered universally throughout the depth of the derma are many mono- or polynucleated inflammatory cells.

28. *First Finger of Left Hand.* (March 16, 1906.)—A pathological condition similar to the last but here the epidermis is intact, exhibiting hyperplasia of the rete and of the horny layer, both of which are infiltrated with many leucocytes usually of the pustular type. Here also evidences of downward proliferation of the rete are visible. Finally there is abundant hæmorrhage everywhere.

29. *Tip of Third Finger.* (March 16, 1906.)—This piece of skin is free from epitheliomatous changes. For long stretches the upper layers of the epidermis are wanting while the corium exhibits in all parts many dilated vessels and multitudinous plasma cells.

30. *Excision.* (November 4, 1906.)—This section, the last in this long series, exhibits undiminished evidences of epithelioma.

The horny layer is practically non-existent, the granular layer is normal. The rete is in places thickened and displays numerous infiltrating leucocytes and at its germinate layer evinces signs of downward-penetrating proclivities. Papillæ are present and bear slightly dilated vessels. The subpapillary layer is delicately reticulated and holds frequent plasmomata and distended vessels containing fibrous meshes and occasional polynuclear leucocytes. Just below this level lies another series of plasma cell masses whose characteristics are strikingly visible and immediately subjacent are extensive areas of epithelial whorls and lobules surrounded by still further plasma cells.

The outer lamellations of these whorls show well differentiated prickles; but within lie degenerated, puffed cells, free from prickles and at times from cell boundaries, containing frequently giant nuclei or no nuclei at all and more mitotic figures than in the previous pathological history of the case. Finally, in the very centre of some of the whorls are found large cysts partially filled with coagulated fibrin, giant nuclei and abundant chromatic remains. Where these cysts appear the epithelial masses are more "pearly" than elsewhere.

This, then, is the detailed description of the pathological side of this discouraging history, and it is distressing to find at the end of this long series a slide exhibiting the most active phases of the disease.

One who has read the histological minutiae of the case will be struck, presumably, by the manifold varieties of the pathological structures. Almost every known phase of epidermic deviation has been encountered, and the cellular, vascular, and protoplasmic alterations and degenerations have been most varied and interesting. The one striking omission in the case has been the unexpected absence of all pigmentary signs, especially when one remembers how prominent a clinical feature pigmentation is in X-ray dermatitis and its epitheliomatous sequelæ.

PHAGEDENIC ULCERATION OF BOTH BREASTS DURING THE PUERPERIUM.

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OF PITTSBURG, PA.,

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THE following case is reported on account of the rarity of phagedenic ulceration other than the venereal type, and as an example of the rapidity with which such a process extends, well known in pre-antiseptic days, rarely seen now.

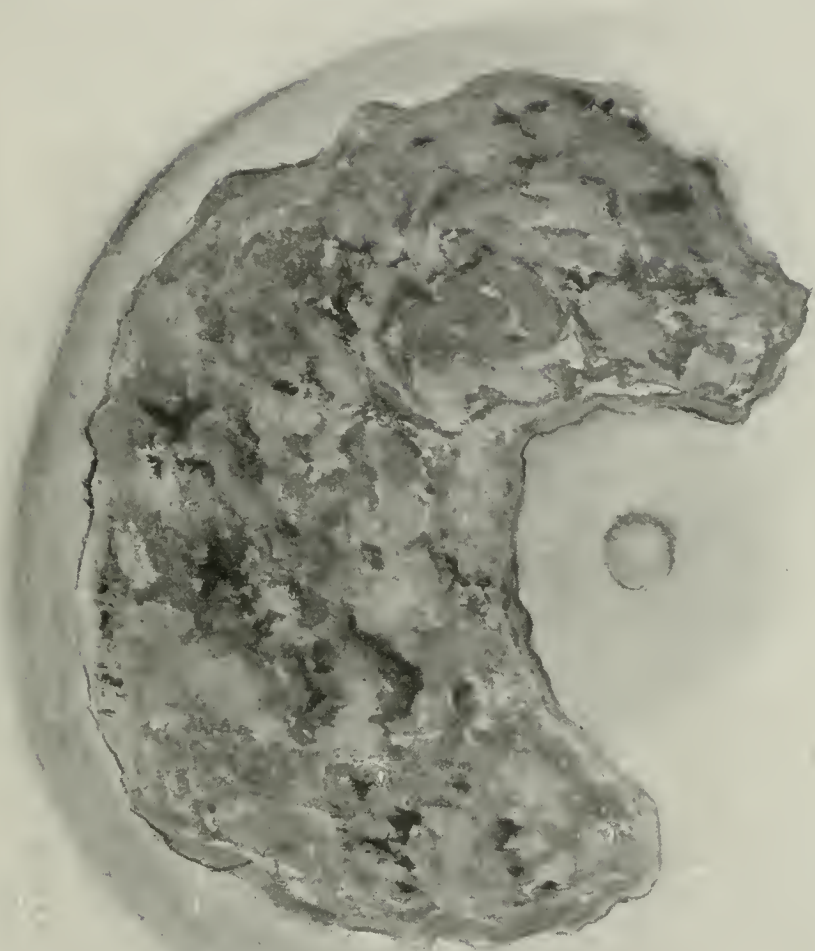
Mrs. J., aged 20, admitted to the Pittsburg Hospital December 17, 1906. Family history negative.

Previous history.—Delivered of a healthy child three weeks ago after a normal labor. Puerperium apparently normal until about one week ago, when child refused to nurse, and patient noticed that both breasts were enlarged, painful, and tender to touch. Nursing stopped. In a few days a small surface appeared on each breast just below the nipple, which was extremely tender and painful and which spread with great rapidity. The leaves of some plant were applied to both surfaces.

Present condition.—Skin of face a peculiar yellow color, with bright, flushed cheeks, pupils contracted, tongue dry, tremulous, and coated in patches; lungs, broncho-vesicular breathing over anterior surface both sides, with few moist râles; respiration 62; heart, both sounds weak, first sound seems somewhat blurred, very rapid, slightly irregular; pulse 140, slightly irregular, fairly good volume, not compressible; abdomen negative; pelvis negative; temperature 104° F.

Breasts.—Both were the seat of extensive ulceration of an irregular horseshoe shape, with the nipples in the centre. (Figure 1.) The ulcers measured approximately 20 cm. from side to side and 10 cm. from above downward and were scarcely more than 1.5 cm. deep at any point. The edges were sharp, gnawed out and undermined, the surfaces covered with dirty, grayish, sloughing tissue, with but little discharge—a typical picture of phagedenic ulceration. The process had attained its present dimensions in four days. The glandular tissue proper of the

FIG. 1.



Phagedenic ulceration of both breasts.

breasts was soft and presented no evidence of any inflammatory involvement.

Smears and cultures from the ulcers showed a mixture of staphylococci, streptococci, and pneumococci. A blood culture revealed the presence of staphylococci and a gram negative bacillus resembling the bacillus typhosus. The leukocytes upon admission were 15,200; two days later 9,600. Urine 1007, albumin present, granular casts.

The ulcers were thoroughly cauterized with pure bromine, which stopped the process at once. The accompanying plate gives a fair idea of the appearance of both breasts several days after cauterization and after the separation of most of the sloughing base. It is worthy of note that the areola surrounding the nipples appeared to offer a more effective barrier to the spread of the disease than other portions of the skin, as shown by the shape of the ulcers. The patient failed rapidly and died January 4, 1907, from toxic nephritis and diarrhœa. It is regretted that no autopsy was permitted.

CUTANEOUS HORNS.

A REPORT OF THREE CASES.

BY CHARLES K. ROYS, M.D.,
OF WEIHSIEN, CHINA.

THESE cases seem worthy of notice, not merely as surgical curiosities, but as giving some light on the connection between horns of the skin and epithelioma. In one case at least of those here given (No. II), the two processes of horn-production and extension of an epitheliomatous ulcer, could be seen going on side by side. Any reference to the etiology, pathology, or general literature of this subject would be superfluous so soon after the excellent article in *ANNALS OF SURGERY*, June, 1906, by Nietert and Babler of St. Louis. So the present writer will confine himself to the simple clinical report of his cases.

The fact that these cases occurred in native Chinese does not prevent their having a bearing on the problem stated above. Nor does the fact that all three cases were seen within six months time, indicate that this trouble is especially common among the Chinese. Practitioners of long experience in China tell me they have never seen a case. This may be said, however, that such cases go untreated much longer here than in countries where medical and surgical aid is more readily accessible, so that end-results of pathological conditions are more often seen.

CASE I. *Cutaneous Horn Lobe of Right Ear. Excision.*--A man, aged 67, had from childhood a small, warty mass on the back of the lobe of his right ear. It grew slowly till he was over 50 years of age, but for the past 12 years it has been growing more rapidly, producing a hard, painless projection, often cut off by the patient with a knife. Two years before admission, it fell off leaving a rough, irregular base, about 1 inch in diameter. In two years it grew again to its present size. It caused pain

FIG. 1.



Cutaneous bone of auricle.

when pulled or moved, so that the patient carried it suspended in a cloth bag, which hung from his ear.

On examination the man appeared fairly well-nourished and healthy, with nothing abnormal except the above-mentioned horn. This was a black, moderately hard projection, hanging loosely from the lobe of the right ear and the adjacent skin over the mastoid process. It was attached to the skin only, and had stretched the lobe of the ear to a length of about two inches. It was curved like the letter J, measuring 9 inches around the curve and $2\frac{1}{2}$ inches in circumference at the base. Its surface was smooth and moderately hard; near the base it was rough, with longitudinal grooves and striations partly filled with sebaceous matter and dirt, not having been washed in the two years of its growth. The skin at the base was red and tender, with no ulceration, but with fleshy projections $\frac{1}{2}$ inch in height, close around the base of the horn, which was slightly separated from these projecting papillæ and from its base on one side. No lymphatic enlargement (Fig. 1).

Treatment.—Excision under cocaine anæsthesia, cutting off the redundant lobe of the ear, and going through healthy skin, $\frac{1}{4}$ inch wide of the base of the horn.

Note.—The longest horn referred to by Nietert and Babler was in Soubervielle's case, with a length of 10 inches. The rate of growth is not stated. In Case I of this series the horn grew 9 inches in two years.

CASE II. *Cutaneous Horn of the Lip, Becoming Epithelioma. Excision of $\frac{3}{4}$ of lip, and Right Submaxillary. Lymphatics.*—A man 60 years of age had for 20 years a hard painless mass growing from his lower lip, just to the right of the median line. He gave no history of syphilis, traumatism or other possible cause. When the mass grew large enough to interfere with eating, he would cut it off with a razor. He estimated that he had cut off about 2 inches in this way. He was a constant smoker of a long pipe with a metal mouth-piece, which he always held on the left side of his mouth, to avoid the growth. For the last two years he noticed a lateral growth of the mass across his lip, to the left, in addition to the longitudinal growth of the horn. The lateral growth was painful on pressure, and sometimes the seat of spontaneous shooting pains. It was usually covered with a crust, and sometimes bled.

On examination the man was found in fairly good condition, with the exception of his lower lip. On the vermilion border of the lip, just to the right of the median line, is the small, truncated, horny mass mentioned above, about the size of a navy bean; its surface rough and cracked, the skin around it hardened and infiltrated, especially to the left along the free margin of the lip, which is involved to the left angle of the mouth in an ulcer with a hard nodular base, rough necrotic surface, and slight purulent discharge. At the anterior margin of the ulcer, beginning in the median line, and extending $\frac{3}{4}$ of an inch to the left, is a low palisade-like projection of horny tissue, about as thick as a finger-nail and $\frac{1}{4}$ of an inch high, of a shiny yellow color, and showing fine vertical striations like those seen on the finger-nails. According to the patient's account, the growth of this has proceeded *pari passu* with the growth of the ulcer across his lip. Submaxillary and cervical lymphatics not enlarged.

Treatment.—Under chloroform anæsthesia, the entire contents of the left submaxillary triangle including the platysma were excised *en masse*. The wound being closed and protected, the left $\frac{3}{4}$ of the lower lip was excised, the defect being filled by a square lateral flap from the left cheek, procured by two horizontal incisions after the method of Malgaigne. The sutures were two of silver wire including the thickness of the lip; deep interrupted silk for the skin surface, and interrupted iodine catgut for the mucous membrane. The patient made an uneventful recovery.

Note.—Paget's case (*loc. cit.*) showed "spur-shaped sharp-pointed projections about the base of the ulcer" (a soot-cancer). This case (No. II), showed unmistakable horny tissue as part of an epitheliomatous extension from a primary focus of horn. I regret to say that the specimen was lost, and that the opportunity for histological examination was lost with it. It was also impossible to get a useful photograph with the small camera at the writer's command.

CASE III. *Multiple Cutaneous Horns of Glans Penis. Amputation.*—A man 26 years of age had from childhood a growth on the right side of the glans penis. His habits were good, and he was effectually protected from venereal disease, as intercourse was made impossible by the growth. He first noticed a small pimple, which became a wart-like mass, and gradually multiplied itself spreading over the right side of the glans penis until there

were about 25 small, hard, horny projections. The upper $\frac{1}{4}$ of the mass grew much faster than the rest, forming a long, curved, finger-like projection, which he cut off repeatedly with a knife because it caught in his clothing. He estimated the total growth at about 3 inches. The whole mass was painful if rubbed or struck. It did not interfere with micturition, but quite prevented intercourse. As it is the duty of every Chinese to acquire male descendants, he sought treatment to remove this disability.

On examination he was found to be a healthy, powerful man, normal except for his genital organs. The right half of the glans penis was occupied by a rough nodular mass. The upper $\frac{1}{4}$ of this mass was in the shape of a truncated pyramid, $\frac{3}{4}$ of an inch square at the base, and about 1 inch high, showing longitudinal striations at the sides and a smooth, cut surface at the top about $\frac{1}{2}$ inch in diameter. Below this, and bounded by the sulcus, were 25 or 30 wart-like projections, hard and horny, and embedded in a crust from the ulcerated surface around and between them. These are limited to the right side of the glans, except one which lies just to the left of the frænum, below the meatus. The mass rests on a base about $\frac{1}{3}$ of an inch thick, indurated and firmly fixed to the tissues of the glans. Lymphatics in both groins enlarged slightly tender, soft and movable.

Treatment.—Amputation of glans penis, leaving corpora cavernosa almost entire, and dissecting out urethra through glans almost to the meatus. Urethra split for a short distance on its under surface, and margins united to skin by silk sutures. Recovery was uneventful.

Note.—In Bellamy's patient (loc. cit.) "the horn grew from the clitoris and resembled the claw of a lion." Size not mentioned. In this case the horn, growing from the analogous organ, reached a total length of at least 3 inches. The uncleanly habits of the Chinese may help to account for frequent disease of the glans penis. In the six months since opening the hospital of which the writer has charge, there have been seen frequent soft and phagedenic chancres, three cases of carcinoma, and one of actinomycosis of the glans and prepuce.

TRAUMATIC HEMATOMYELIA,

WITH A REPORT OF A CASE.

BY MILTON R. BARKER, M.S., M.D.,
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HEMATOMYELIA is a term applied to a hemorrhage that takes place within the substance of the spinal cord. It is always intra medullary. That we should fully understand this condition, we should briefly review the anatomy of the blood supply of the cord. The blood is supplied by three main arteries and their branches, one anterior and two posterior spinal arteries, all three of which are branches of the vertebral; they are given off from the vertebral near where these join to form the basilar. The two anterior spinal trunks unite in a single artery in front of the medulla, which extends the entire length of the spinal cord in front. It is imbedded in the pia mater and lies in front of the anterior median fissure. The two posterior spinal arteries pass from their origin to the postero-lateral borders of the medulla and proceed separately the whole length of the spinal cord, being located just behind the posterior nerve roots. These arteries are also imbedded in the pia mater. The spinal arteries receive accessory branches along their course from the thyroid, intercostal, lumbar and ilio-lumbar arteries, through the intervertebral foramina, and give off numerous branches to the substance of the cord, through which the cord receives its vascular supply. As before noted, both the anterior and posterior spinal trunks are imbedded in the pia mater, hence are external to the cord. Therefore all hemorrhages that may take place from these trunks will not produce hematomyelia. If the rupture in the arterial wall is so located that the bleeding takes place into the subarachnoid space, hematomyelia does not result. In other words, the hemorrhage must take place in such a manner that the cord substance is invaded by it to produce hematomyelia. In hema-

tomyelia the damage is usually wrought in the gray columns of the cord, these offering the least resistance to the flow of blood, yet in some cases in which the hemorrhage is profuse the white tracts are invaded, but in these cases the blood does not follow the white tracts for any considerable distance, the axones acting as a barrier to its progress.

The ætiological factors in the production of hematomyelia are diseased conditions of the arterial walls; for instance, arteriosclerosis or conditions due to specific disease and traumatism. The former may be present, the latter is always present. The hemorrhage may be in the traumatic area or remote from it, the latter usually prevailing in uncomplicated cases. When the hemorrhage takes place in the traumatic area, the bony wall of the spinal canal is either crushed and splinters of bone pierce the substance of the cord, or it is pierced by knife or bullet wounds. In these cases much damage is wrought to the bony wall, membranes of the cord, and the cord itself, and the hematomyelia thus produced is only a part of the general destruction. While hematomyelia exists in these cases, it is not that uncomplicated form the symptoms of which are at times obscure and the diagnosis difficult, nor that form which we wish to emphasize in this paper.

The form of hematomyelia with which we are dealing takes place in the cervical cord, remote from the traumatic area, and usually follows the violence immediately, but may be postponed for several days or weeks. Its constant site in this class of cases being the cervical region, by reason of the fact of the great mobility of the spinal column in this region. Traumatism applied to the nates, by falling, or by being struck by ponderous bodies, or applied to the lumbar or dorsal regions producing a sudden exaggerated extension or flexion of the cervical spinal column, may rupture either the anterior or posterior spinal arteries, by over-stretching or by forcibly dragging them against the bony wall of the spinal column. If the arterial walls are diseased the chance for their rupture is greatly enhanced. The traumatic insults in this class of cases may be severe, or so slight as to escape detection by external

appearances. In those cases in which the hemorrhage immediately follows the injury, the walls of one or more of the arteries are completely ruptured, but in that class of cases in which the hemorrhage takes place at some rather remote time, as several weeks or two months after the injury, it is probable that at the time of the injury, while the walls of the arteries are not completely ruptured, that their coats are so injured that they later give way, or perhaps only the intima-vasorum is ruptured, an aneurism following, which later ruptures producing the hematomyelia. I believe the above is a reasonable solution of these postponed hemorrhages. These vessels at the point of rupture are subjected to considerable blood pressure, being in quite close proximity to the heart.

As before noted, the damage to the cord is usually confined to the gray columns, and may be much or little according to the amount of bleeding. If the hemorrhage is considerable it will push its way through the gray columns for a distance of three or four segments of the cord above and below the bleeding point. Should the hemorrhage involve the third, fourth and fifth cervical cord segments, serious results will follow, the nerve centres of the phrenic being involved and paralysis of respiration resulting. In the form of hematomyelia of which we are speaking the upper extremities, and the rest of the body below the lesion, will be more or less involved and more or less permanently involved, according to the amount of bleeding that has taken place into the cord.

These hemorrhages may be divided into four categories as follows; local, profuse local, disseminated, and profuse disseminated. The neuroglia tissue in the gray columns of the cord offers greater resisting force to the flow of blood in some cases than in others. Hence in those cases where there is a marked resistance by this tissue, the blood does not make channels between the fibres of the neuroglia tissue and become disseminated through the gray columns, for the distance of a number of cord segments, but pushes the neuroglia tissue from it on all sides, stretching and breaking down its fibres and thus forming a pool of blood or perhaps several pools, which

pools form clots, that occupy more or less completely the gray columns for a space of perhaps three or four cord segments in close proximity to the bleeding point. The pressure of these clots upon the delicate tissues of the neurons, causes softening and destruction of them. When the mass of blood clot, and dead neurons is absorbed, cavities are left in the cord substance, and the functions of that part of the system presided over by these nerve cells and axones are permanently lost. These cavities in the cord later fill up with connective tissue. The larger the clot the greater will be the destruction of nerve tissue and the greater the loss of function. A small local hemorrhage may produce little or no permanent damage, while a profuse local hemorrhage, will cause permanent loss of function over a large area of the system. In the disseminated hemorrhage the blood makes its way between the neuroglia fibres and about the cells in the gray columns, permeating the substances of these columns for a distance of eight or ten cord segments, but pools of blood do not form, hence there are no clots to produce pressure and destroy nerve tissue. Hence permanent loss of function does not follow this form of hemorrhage, while in the profuse form of disseminated hemorrhage, clots form throughout the disseminated area, and produce pressure on the nerve cells and axones, causing softening and destruction of them, and when these small masses are absorbed numerous small cavities are left in the cord substance, and permanent loss of function occurs over numerous areas of the system more or less remote from each other.

Some of the important things to be remembered in connection with hematomyelia are first, profound general conditions that may follow apparently slight traumatism applied to the spinal column in such a way as to cause extreme extension or flexion of the cervical segments of the cord. Second, profound conditions involving the cervical cord, due to traumatic insults perpetrated at a distance remote from the cervical region. Third, the cord lesion may appear many days or several weeks after the traumatic insult is received. Fourth, if the hemorrhage is profuse and local, permanent damage to

function will result to large contiguous areas in both upper and lower extremities, while if the hemorrhage is profuse and disseminated, permanent damage to function will result in many areas, in both upper and lower extremities more or less remote from each other. If the hemorrhage is small and local, or slight and disseminated, no permanent damage to function will result. Fifth, all forms of hematomyelia improve for about eighteen months, after that little improvement may be expected. Sixth, a guarded prognosis should always be made.

As to the diagnosis of this condition we have no means at our command for making anything more than a probable diagnosis of hematomyelia. Lumbar puncture in suspected cases has been advocated, but as a matter of fact is worse than useless. If blood should be found by this measure in the cerebro spinal fluid, it would not be of diagnostic value, as it would only prove that hemorrhage had taken place into the subarachnoid space, the only portion of the spinal canal, normally occupied by cerebro spinal fluid.

In a hypothetical case, in which paralysis of a portion of the upper and lower extremities, followed immediately a traumatism to the spinal column, remote from the cervical region, the paralysis increasing in extent and severity for several hours after the violence, without cranial nerve involvement. In a youthful patient free from disease, we would be justified in making a diagnosis of hematomyelia, but even in such a case we would think of hysteria as a possible cause of the condition, while in another case less clear, we would have to consider the possibility of scattered foci or morbid tissue changes in the cord due to latent degenerative changes, which have become active by reason of the traumatic insult. As a rule, however, the difficulties are greater in making diagnosis in real cases than in the hypothetical ones. Nevertheless with disseminated inhibition of physical function, in the upper and lower extremities, with increased reflex activity, and exaggerated tremors, following traumatism to the spinal column, more or less remote from the cervical region with no cranial

nerve involvement, a diagnosis of hematomyelia is the most probable. If the symptoms of hematomyelia do not appear until a time more or less remote from the date of injury, differential diagnosis is more difficult, for the reason that more time has been provided in which latent degenerative conditions may become active. Even after the lapse of eighteen or twenty months, we may not be able to decide positively what was the true condition.

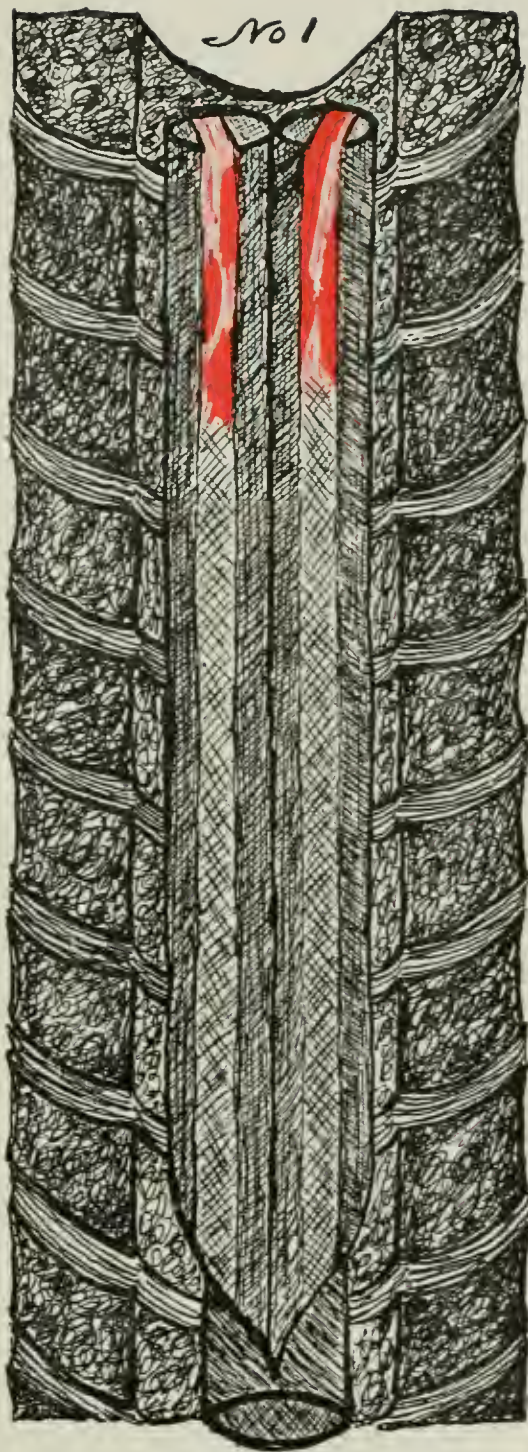
In slight hemorrhages either local or disseminated the patient will completely recover. The same result will follow hysteria as a rule, hence complete recovery does not decide for hematomyelia. In profuse hemorrhages the patient will improve for a time, but never fully recover. The same may occur in degenerative conditions. Hence we believe in a majority of cases we will not be able to make anything more than a probable diagnosis of hematomyelia, either at the beginning or end of the case.

The following illustrates a probable case of hematomyelia, the hemorrhage being postponed, profuse and local.

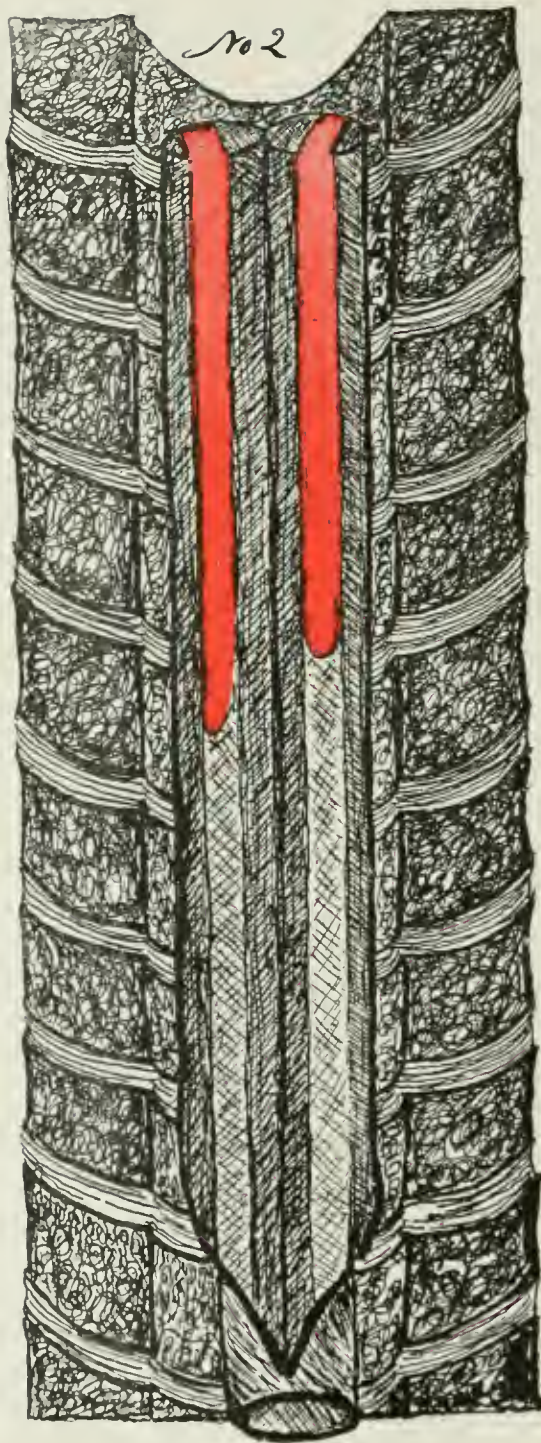
Mr. J., aged 33 years, teamster by occupation, denies having had any venereal disease or illness of any kind. Patient was thrown from his wagon striking his back, a little to the left of the spinal column, on the curbstone, sustaining a fracture of the seventh and eighth ribs near the column. I saw this patient a few moments after the injury occurred. The fractured ribs were cared for in the usual manner. The patient made a rapid recovery and in six weeks resumed his duties as teamster. Eight weeks after the injury, while caring for his team, preparatory for the day's work, suddenly and without warning, his lower limbs gave way and he settled down in a bunch on the barn floor. Two neighbors who happened to be present tried to assist him to his feet, but found that he had lost the use of both upper and lower extremities. He was perfectly conscious, could talk without difficulty, and knew all that was going on about him. His friends carried him into the house and put him to bed. I saw the patient a half an hour later. Sensation and motion were lost in the entire right lower limb, so profound was the condition in

this limb, the patient could not tell where it was unless he could see it. Motion was lost in the left lower limb below the knee and greatly impaired above the knee, but not entirely lost. Sensation in this limb was not completely lost, patient could tell when his left limb was moved and would respond to the prick of a pin. The right arm was paralyzed over the areas supplied by the musculo spiral, median and ulnar nerves, while the left arm was paralyzed over the areas supplied by the musculo spiral and median nerves. There were none of the cranial nerves involved, and the functions of micturition and defecation were at no time involved. Some little improvement in sensation commenced in the area supplied by the ulnar nerve three months after the paralysis occurred. Two months later both arms commenced improving over the entire areas involved. At the end of six months some improvement commenced in the lower limbs. Sensation began to appear in scattered areas over the right leg. At the end of twenty months the patient was able to use his arms in a manner—he could feed himself and partially dress himself, and use a cane in each hand. He had also regained the use of his limbs, so that he could walk in a way. He had better use of the limbs above than below the knees. He walks by raising the limb above the knee and then swinging the lower limb forward. It has now been about thirty-four months since the injury, but there has been no improvement for fourteen months. At the time of the injury the patient weighed 180 pounds. Six months later he weighed 120 pounds and at the present time weighs 140 pounds, but has not gained any in weight for a year. The knee jerk is exaggerated at the present time, while the Argyle-Robertson pupil and Romberg's sign cannot be demonstrated. This patient has never suffered pain, has never had a rise of temperature, and the pulse and respiration have always been normal. Neither has there at any time been tenderness anywhere along the spinal column, or any discoverable abnormality connected with it.

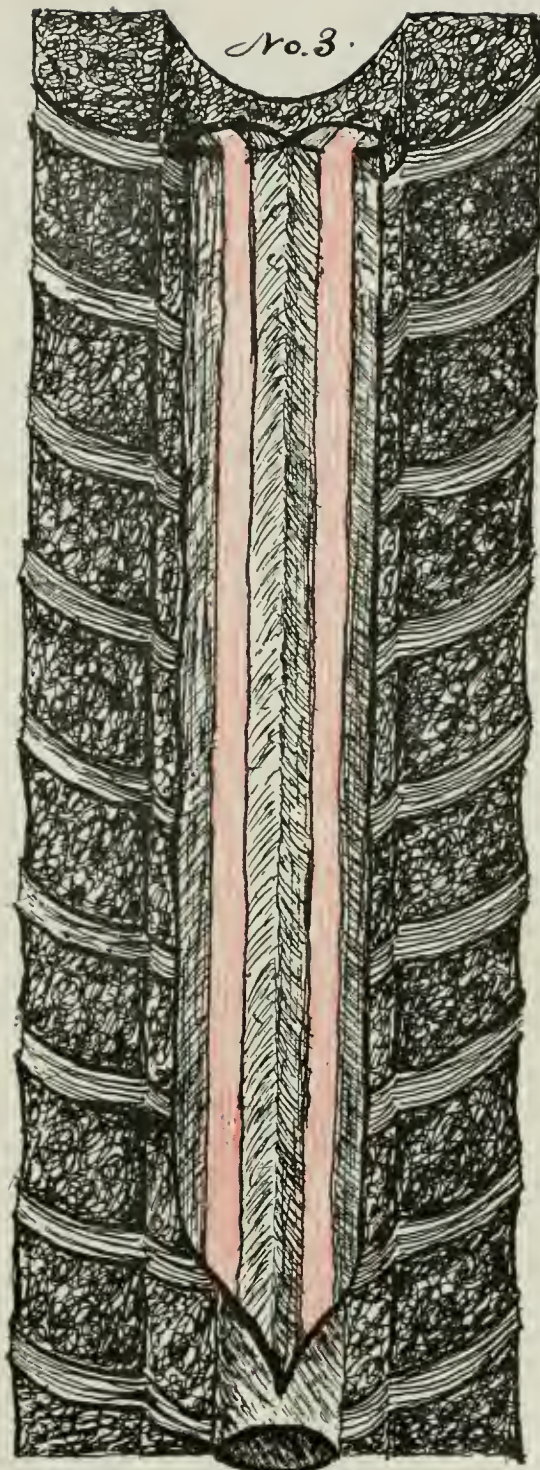
It is impossible for us in this case to positively associate the traumatism with the hemorrhage that occurred at so remote a period. We are well aware that hematomyelia occurs sometimes without traumatism, but in such cases the arteries are diseased. In the case presented there are no evidences of dis-



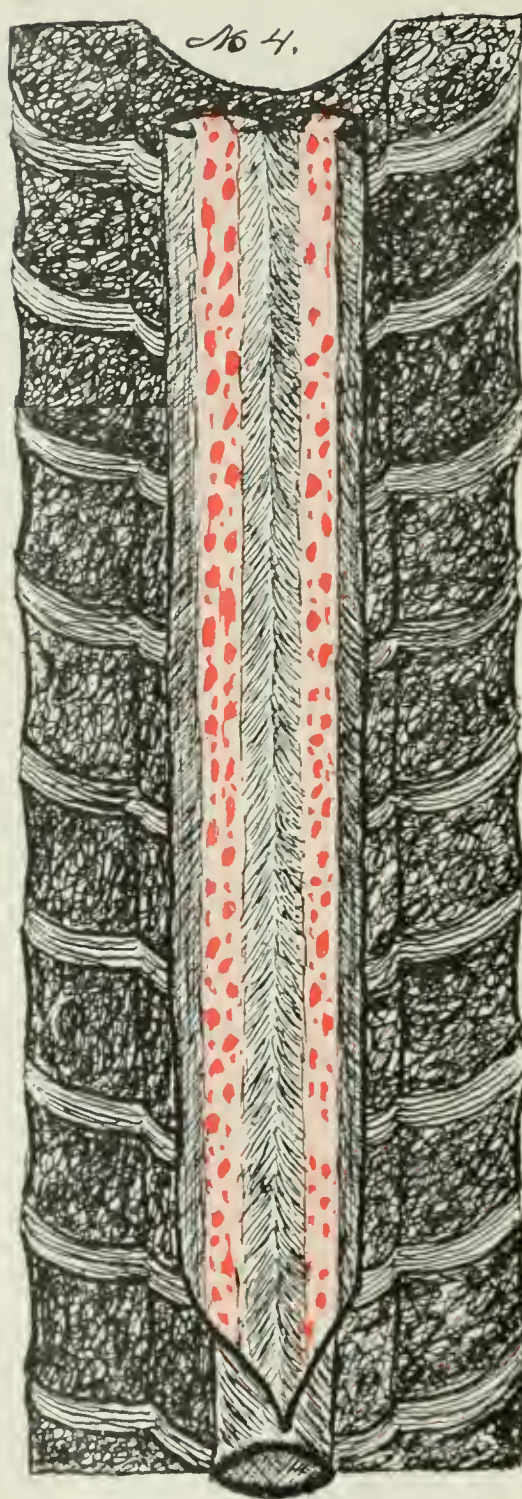
Slight local hemorrhage.



Profuse local hemorrhage.



Slight disseminated hemorrhage.



Profuse disseminated hemorrhage.

ease. We may regard the case from two view points: Was the hemorrhage due to the traumatism, or did it occur independently of it? In other words, would this patient have had his hemorrhage if he had not received the injury? Which is the more reasonable of the two conditions? To me, the former is overwhelmingly impressed as the true one.

It is only comparatively recent that hematomyelia has been recognized as a pathologic entity. For many decades it was one of that group of unknown conditions (except symptomatically) known as railway spine. How many conditions were contained in this group is not known, but it is certain that one of the most important of the group was removed from it when hematomyelia was identified and placed in a category by itself. We now find ourselves facing a new danger; that nearly all cases that were once known as railway spine are now placed, or in danger of being placed, in the category of hematomyelia. As a precaution against this, we can do no better than quote from Leube. "The diagnosis of spinal apoplexy should only be made with the greatest reserve. The sudden onset of the disease, the apoplectiform appearance of paralysis, the most important support for the diagnosis, are also noted in other affections of the cord, especially now and then in acute myelitis. Only when certain etiological conditions simultaneously are in favor of the diagnosis of spinal-cord hemorrhage; a fall, a severe blow upon the back, fracture of the vertebræ, the existence of a marked hemorrhagic diathesis or of a atheroma; a little more certainty in the diagnosis is permissible."

The drawings, Nos. 1, 2, 3 and 4, illustrate a section of the spinal column, with a portion of the arch of each vertebra removed, revealing the cord in the spinal canal. The cord is laid open at the posterior median fissure and each side turned half over showing the hemorrhage in the gray columns in each side of the cord.

NERVE DISASSOCIATION; A NEW METHOD FOR THE SURGICAL RELIEF OF CERTAIN PAINFUL OR PARALYTIC AFFECTIONS OF NERVE TRUNKS.*

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Garretson Hospital.

Summary.—The following is a preliminary report giving the results obtained in treating certain forms of paralysis or paræsthesia due to injury or inflammation of nerve trunks by isolating the affected part of the nerve through an incision, freely opening the nerve sheath, disassociating the component fibers, and isolating the nerve from later fibrous tissue compression. The neurolysis is intended to permit the escape of exudate from within the nerve sheath, to reduce pressure upon individual nerve fibers; to free axis cylinders which have become useless through entanglement in scar tissue, to facilitate the formation of new or the restoration of old nerve paths, and to stimulate desirable trophic changes in the nerve trunk.

The influence of pressure within the nerve sheath as a cause of palsy and anæsthesia was brought to our notice in November, 1905, by a patient who had sustained a small incision of the median nerve from a piece of flying glass. On exposure of the injured nerve it was found that the nerve was not divided, but was the seat of a marked fusiform enlargement. Upon incision of the affected area there flowed from between the nerve fibres a gelatinous and serous fluid. In this patient nothing was done except to make a free longitudinal incision into the nerve. Four days later, upon testing the hand it was found that the area of anæsthesia had decreased

* Read in part before the Northeast Branch, Philadelphia County Medical Society, February 18, 1907.

one-third and that there was a distinct increase in the ability to flex the fingers. The prompt improvement in this patient was very suggestive, and later we gradually developed a method of treating certain forms of neuritis that have produced paresthesia or paralysis and also a possible means of inducing regeneration along nerve paths blocked by areas of cicatricial tissue. Unfortunately, our experience with this new operation, while encouraging, has been limited to four cases, and this preliminary report is made, therefore, with the hope that a wider application may more precisely determine its field of usefulness.

Technique of the Operation.—After sufficiently exposing the affected nerve through an incision, the nerve is isolated from adjacent tissues and a free longitudinal incision of the nerve sheath made. The sheath should be divided, if possible, well beyond the limits of the lesion. The nerve trunk is then lifted upon one or two fingers, held taut, and the nerve fibers carefully separated from each other by means of a small, sharp tenotome. Care is taken to divide as few nerve fibers as possible, although it is aimed to freely separate the nerve fibers from each other. As the nerve fibers become separated, the nerve is transformed from a rounded cord to a flat ribbon-like band of separated fibers. If cicatricial tissue is encountered in the nerve trunk the separation of the fibers is prolonged along straight lines dividing the scar into multiple parallel threads of tissue. Having freely disassociated the nerve fibers, if the nerve were previously imbedded in cicatricial or fibrous tissue it should be removed from this area, or at least isolated from future cicatricial adhesions by the interposition of adipose tissue, strips of which can usually be secured from beneath the skin. In one of our cases, the musculo-spiral nerve was transplanted from the musculo-spiral groove into the subcutaneous fatty tissue. In two other cases we have laid thin strips of adipose tissue between the nerve and its normal bed. Of seven cases in which we have partially or thoroughly disassociated nerve fibers, in only one were we able to detect an increase of the paralysis immediately following the operation, while in

several there was an almost immediate increase of function in the affected nerve field. In three instances the nerve trunks were split for purposes of nerve transplantation. During the operation it is important that the nerve be handled gently, be not subjected to strong traction, and that the knife be sufficiently sharp to separate, without unnecessarily pulling, tearing, or bruising the nerve fibers. Theoretically, it may be assumed that the operation may be of benefit in a number of ways as follows:

FIRST. *The relief of tension within the sheath.*—The free disassociation permits the immediate escape of interfibrillar exudate. The pressure of the constricting nerve sheath is relieved, intraneural collections of fibrous tissue are divided and constricted nerve fibers freed. This is well shown in Case I.

SECOND. *The operation may be useful in permitting a rearrangement of nerve paths.*—In the process of disassociation it is inevitable that many axis cylinders will be divided or torn free from their connections. Thus there is left along the tract of the operation, numerous free ended axis cylinders in condition to form new anastomoses with a possibility of the reestablishment of many nerve paths previously interrupted. For example, in brachial birth palsy, or after traumatic division of nerves, the divided nerve fibers may become entangled in the new forming connective tissue and remain buried and incapable of function. In the process of disassociation these nerve fibers are freed from their entanglements, divided, and are left adjacent to other divided fibers, with some of which they may anastomose, reestablishing the function; or again, other divided short segments of nerves may by forming attachments at each end serve as bridges over the gap caused by the injury.

THIRD. *The operation may facilitate the bridging of cicatricial gaps in nerves.*—If a nerve has been divided and the ends finally joined by a mass of scar tissue, say one-half inch or more in length, the separation and freeing of nerve fibers above and below the fibrous area, and the splitting of the

cicatricial connecting band into threads of tissue with innumerable interspaces between, should, theoretically, at least, place the freed axis cylinders in a most favorable condition for growth and ultimate anastomoses along the guiding trellis-like strands of fibro-connective tissue. It would seem that such a fibrillated fibrous bridge should give much better results than where the divided and separated nerve ends are bridged by catgut or other foreign material. Moreover, all residual nerve filaments are conserved and there is no sacrifice of nerve tissue such as occurs when the cicatricial area is excised or resected. While after primary nerve injuries the immediate exudate and hæmorrhage may be prejudicial to anastomosis; in nerve disassociation the field is practically free from blood, the opportunities for drainage are good and there should be little interference by the pressure of exudates.

CASE I.—*Partial division of the median nerve with localized infiltrative neuritis. Prompt partial return of function after incision into the nerve.*—M. G., 32 years old. Well nourished. Previous history negative. In September, 1905, a piece of glass from an exploding bottle of soda water made a short incision about two inches above and one inch internal to the line of the internal condyle of his left arm. This was followed by inability to flex the index and second fingers and anesthesia of the entire palmar surface and the terminal portions of the dorsal surfaces of the first two fingers. There was no paralysis of the thumb, and adduction and abduction of the fingers were retained. Two months later the patient had partially regained the power of flexion of the second finger. On November 22, 1905, the patient entered the Samaritan Hospital. The median nerve was exposed opposite the superficial scar. In this area the nerve showed a grayish, fusiform expansion of about three times the calibre of the normal nerve. This enlargement of the nerve trunk was freely incised in a vertical direction and a marked gelatinous and serous infiltration between the fibers found. The wound was closed in layers without drainage. Four days later the area of anæsthesia over the palmar surfaces of the finger was found to have decreased about one-third. He could partially flex the first finger at the knuckles, but not at the interphalangeal joint. After

this immediate improvement there was little change for ten months. Recently a progressive increase in power has been reported. In this case the thorough disassociation of fibers used in the later cases was not carried out.

CASE II.—Progressive musculo-spiral neuritis following traumatism. Nerve-stretching; temporary relief from pain and complete palsy of musculo-spiral nerve. Nerve disassociation, with immediate partial return of motion and relief from pain, secondary return of some of the symptoms, and final progressive improvement.

History.—A. S., 32 years old. (Patient of Dr. W. A. Steel.) Mill hand. Previous history negative.

History of Neuritis.—Six years ago patient fell from a bicycle bruising an area over the left musculo-spiral groove. Following the injury an intermittent neuralgia appeared in the field of the musculo-spiral nerve and continued for five years. Ten months ago the neuralgia became constant and there was a gradual decrease in the power of the extensor muscles of the forearm. Rest, counter-irritation, and internal medication failed to relieve the symptoms.

Operative Treatment.—In September, 1906, the patient entered the Samaritan Hospital, the nerve was exposed in the musculo-spiral groove (Dr. Steel), freed from its adhesions and stretched. Complete musculo-spiral paralysis followed the operation. The pain was relieved for a few weeks, but gradually returned with increasing severity. There was partial ability to flex the fingers and thumb (median and ulnar nerve), but this was impaired. Electricity and massage were used. Three months later, the pain continuing with great severity, the nerve was exposed (Drs. Steel and Babcock) over a distance of seven inches and it was found shrunken and grayish in color and adherent over an area one inch in length corresponding to the site of the injury. The nerve was isolated, the nerve sheath opened, and the nerve fibers freely disassociated from the upper fourth of the humerus to the elbow. The nerve was then lifted out of its groove between the heads of the triceps and transplanted into the deep subcutaneous fat. The immediate effect of the operation was relief from the pain and the ability to extend the fingers and wrist from the splint, indicating some restoration of the musculo-spiral function. About a week later there was a

partial return of the pain, and this continued for two months after the operation, when the nutrition of the hand and forearm having improved there was a gradual cessation of pain and return of power. Three months after the operation there was no pain in the peripheral distribution of the musculo-spiral nerve, but some tenderness and pain in the axilla and over the clavicle. Flexion, extension, and rotation of the hand and fingers are nearly perfect. Electricity and passive motion have been used, beginning two weeks after the operation. In this case the striking features are the immediate disappearance of the wrist-drop following the neurolysis; second, the return of pain and loss of power, probably from the exudate poured out during the reparative process, and the final relief from pain except in an area proximal to the field of operation.

CASE III.—*Intractable sciatica. Nerve-stretching followed by temporary relief from pain and complete palsy. Return of pain. Disassociation of posterior tibial nerve followed by partial return of motion in twenty-four hours and relief from pain in the field of the disassociation.*

History.—S. K., age 21, single. Factory girl. Previous history negative. Had suffered with neuralgic pains along the course of the left sciatic nerve for eight months not relieved by various constitutional and local measures, including injections about the nerve trunk. She had also been in one hospital for treatment for six weeks and in a second for one week. October 24, 1906, about eight months after the development of the pain, she entered the Samaritan Hospital, and the day following, under spinal anæsthesia by stovaine, the left sciatic nerve was exposed and thoroughly stretched. The operation was followed by immediate relief from pain and complete paralysis of the leg and foot. Six days later the patient began to complain of some return of the pain. As the pain continued and proved progressive, especially in the calf of the leg, on November 26, about one month after the first operation, the patient, under spinal anæsthesia by tropa-cocaine, was treated by exposure and thorough disassociation of the upper third of the posterior tibial nerve. The nerve was then insulated by strips of adipose tissue taken from under the skin and the wound closed in layers without drainage. Twenty-four hours after the operation there was ability to flex the toes one-fourth of the normal range. There

was wound soreness, but relief from the neuralgic pain; later there was some return of the pain in the foot, which subsided under hot baths, so that the patient is now nearly free from severe pain in the leg, although there are some pains about the upper thigh and hip. There is anæsthesia of the anterior surface of the foot and leg, while sensation is present over the posterior surface, and there has been a gradual subsidence of the paralysis. There was in this case, therefore, a partial but immediate return of function in the distribution of the nerve operated upon, which has persisted, while anæsthesia continues in the distribution in the anterior tibial nerve, the branch not treated by disassociation.

CASE IV.—*Intense neuritis of the forearm chiefly involving the field of the median nerve. Disassociation of median nerve followed by increase of paralysis, but marked relief from pain. Gradual resumption of power and increasing relief.*

Mrs. H. T., age 48, previous history negative except two attacks of typhoid fever about the age of puberty. A year ago, one month after moving into a damp house, she noted a sensation of coldness in the posterior surface of the left hand, between the thumb and index finger. The application of water would produce a chill. Increasing lancinating pains shooting from the tip of the index finger along the inside of the arm to axilla developed, with tenderness. The fingers became stiff, could be flexed only partially and at times not at all. The third and fourth fingers remained normal. The pain became so intense that for nine weeks preceding her entrance to the hospital, three hypodermics of morphine were injected into the arm daily. At the Samaritan Hospital, March 26, 1907, the lower third of median nerve in the arm, and likewise the lower half of median nerve in the forearm were exposed by a longitudinal incision above the elbow and one above the wrist, isolated, the nerve sheaths carefully divided and the nerve fibers thoroughly disassociated. Following the operation there was a loss of motion of the first two fingers and thumb, with a sense of marked anæsthesia. The pain was much less intense and the tenderness much reduced. There was some return of motion within a week. Three months after the operation the patient could sleep comfortably at night, had partial flexion of all fingers, some sense of anæsthesia, and increasing freedom from pain. Future experience may prove that it is unwise to disassociate two areas of a single nerve trunk at one time.

Of the four cases in which an operative disassociation of nerves was carried out, three were for painful conditions and these patients obtained marked relief by the operation. In all four there were paralytic symptoms and in three of these cases there was an immediate decrease in the palsy following the neurolysis. In the remaining case, one in which a single nerve was disassociated, along two different areas there was a transient increase in the paralysis. In two of the cases nerve stretching had previously been employed, had failed to give continued relief and had produced immediate palsy. For the present we may conclude:

First.—That the surgical disassociation of nerve fibers may be carried out without producing gross evidence of reduction in the conducting power of the nerve.

Second.—Disassociation probably is not as apt to produce paralysis as thorough nerve stretching.

Third.—That in certain cases of neuritis, nerve disassociation is less dangerous and more potent in relieving symptoms than nerve stretching.

Fourth.—In certain cases of motor paralysis following inflammation or injury of nerve trunks, disassociation may be followed by a remarkable and almost immediate return of some of the function.

Fifth.—In the treatment of certain forms of peripheral paralysis due to interruptions of nerve paths by masses of fibrous or other tissue, the operation of nerve disassociation from its apparent safety and conservatism is deserving of trial. Especially do we feel that it is warranted in cases of brachial birth palsy where no gross lesion is found in the nerve trunks or where extensive resections, anastomoses, or forms of nerve bridging by catgut or other foreign materials would otherwise be employed.

OPERATIONS ON THE SPINAL COLUMN.*

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OPERATIONS upon the spinal column have been numerous, but they have been mainly for the purpose of getting within the spinal canal rather than as operative procedures upon the spine itself. The clinical picture presented by pressure on the spinal cord, whatever the cause may be, is always of the greatest interest. This, I fear, has more or less diverted our attention from a proper consideration of the external aspect of the column, and we have failed to realize that it is the seat of changes which demand operative interference. Consider for a moment the anatomical structure of the spinal column. How great is its length, extending as it does from the skull in its upper portion to the coccyx below, a distance in the average adult varying from 65 to 80 cm., or between two and two and a half feet. Think of the number of its component parts each a distinct unit and liable to the changes from trauma and infection as other bones of the human frame. Look at the great number of joints which are present, which are of two characters, both arthrodial and amphiarthrodial. While their individual amount of motion is extremely small as compared to many other joints of the body, nevertheless, they are prone to many of the changes which cause serious trouble in other articulations. Each individual vertebra is attached to its neighbor by five sets of ligaments, and these are peculiarly susceptible to certain forms of infection, as those produced by the gonococcus. The normal elasticity of the ligament is diminished and a semi-calcareous strand takes its place. After traumatism these ligaments may be pulled away from the vertebral bodies stripping off portions of the periosteum, and form exostoses

* Read before the American Orthopedic Association, May 9, 1907.

of greater or less dimensions. These exotoses may be anatomically situated so as to interfere with the normal motion of the spine and cause pain by impingement of the nerve roots as they emerge from the spinal column. The point of attachment of muscles or of tendons has always been a seat of injury following violent traumatism or strain. The periosteal covering of the bones at these points is injured and permanent damage is often done. When one considers the large number of muscles that are attached to the spinal column throughout its extent, and how very small is the surface of the vertebra free from such muscles, is it surprising that under constant strain which the continual motions of the spine necessitate that there are areas of lessened resistance, the starting point of future trouble? Consider again, the relation of the vertebra to important neurological structures, as the cervical, and lumbar plexuses, and the various intercostal nerves. How narrow is the lumen through which these nerves pass, and how closely are they pressed by the numerous ligaments which hold the adjacent vertebræ together! Proliferations of the edges of these inter-vertebral articulations press directly on them. The contiguity of the nerve elements to the bony structure of the spine offers opportunity for nerve lesions, which have in many cases been put down to a true inflammatory neuritis.

The radiograph has marked a distinct advance in our knowledge of the congenital defects in the spine, and of its numerous variations from the normal which often have a clinical significance. Spina bifida is well known. This is caused when the laminæ of a particular vertebra fail to coalesce. It presents, however, such gross external appearances that the radiograph was not necessary to determine its embryological origin. The small variations, however, resulting in most painful though often obscure symptoms have been brought to light only since the routine use of the X-ray. Thus far has our knowledge concerning the cause of symptoms referable to the brachial plexus been cleared up. Numerous instances of the presence of a cervical rib, or ribs, unilateral or bilateral, are now of such common occurrence that no further mention need be made of

them, but the fact that certain types of neuralgia are due to the pressure of the cervical ribs directly on the plexus has led to the excision of this anatomical variation with complete cure of that group of cases which has for so long a time defied therapeutic remedies. The cervical portion of the spine is the main location of the extra rib, but it is by no means confined to this area. Any of the lumbar vertebræ may possess a rib. Generally when this occurs it is the first lumbar vertebra which is involved and symptoms of pressure on the lumbar plexus result from it, and the cause of these symptoms would be almost impossible to make out unless a radiograph were taken. Any of the five lumbar vertebræ may possess such an appendage, and one of the cases which is the cause of this paper had an extra rib coming off of the fifth lumbar vertebra extending down into the pelvis and was densely adherent to the lumbar sacral cord. It produced a sciatica which defied all kinds of therapeutic treatment for years. Besides the presence of extra ribs other malformations are often met with. Indeed the spinal column has probably more variations from the normal than any other bony structure of the human body. Often the different centers of ossification of the body of the vertebra fail to fuse and the vertebral body remains in two parts between which there is a cleft going directly down to the spinal canal. At times the two sides of the vertebra differ materially in size. It is claimed by some that lateral curvature is due to this asymmetrical development. From Mall's statistics on the embryo one is surprised how often there is a variation from the normal in regard to the number of vertebræ present. Besides the variation in number Böhm before this society at its meeting last year pointed out that the ribs while the same in number on both sides of the spinal column were often asymetrically placed, that is, the ribs on one side of the spine might often be one vertebral body higher than those on the opposite side. This leads to a great many variations in regard to body development. Instead of one rib springing from each side of the dorsal vertebræ two may come off of one side while one comes from the other. This confinement of two ribs within

a restricted space at their point of origin may cause both sensory and motor disturbances as they press upon the emerging nerves.

Trauma is another cause of certain conditions in the spine which at times necessitate operative interference for the alleviation of their symptoms. We operate on fractures of the spine in order to remove the fragments causing pressure on the cord or on the nerves after they have passed through the spinal column. A rupture of the ligaments and the tearing of muscles cause periosteal thickening and fibrous and bony enlargements which impinge upon neurological structures, or press so hard upon neighboring bony projections with the least movement of the spine that they must be removed before permanent cure will result. Another and probably the most important cause of changes in the spinal column where operation is indicated for the relief of symptoms is the various infectious processes and metabolic disturbances. The gonococcus is the organism most often found in the production of these changes. The organism probably attacks the ligament or the periosteum at the edges of the vertebra. The structures undergo the changes commonly seen in gonococcal infection, namely, fibrous thickening and at times calcification. If the periosteum is involved a true exostosis may be formed and the normal motion in the spine brings these exostoses in contact one with another, or with some projecting bony prominence so that a deep-seated pain is produced. Let me recite a case of gonococcal infection involving both feet as well as the spine.

CASE I.—C. C., age 26. Admitted February 16, 1905. Complains of pains in both heels and pain in the back.

Family History.—Negative.

Previous History.—Three attacks of gonorrhœa, the first ten years ago, the second three years ago, the third one year and three months ago. Associated with a posterior urethritis. With the second attack he had a suppurating inguinal bubo. No history of rheumatism, typhoid fever, or pneumonia.

Present Illness.—Began one year ago; that is, three months after his attack of gonorrhœa. It began in both heels simul-

taneously. The pain and soreness have continued ever since, but with increasing severity. Six months ago, while at Hot Springs for the pain in his feet, he was taken with a pain in his back. This pain is present, whether he lies down or is walking about. He walks with great difficulty.

Physical Examination.—Not a robust man. Loss in weight during the past year has been fifteen pounds. Right foot shows a decided thickening of the os calcis. At the attachment of the plantar fascia with the os calcis there is a spot of acute tenderness on pressure. This area measures about one centimeter. There are no acute inflammatory symptoms. Stretching of the plantar fascia causes the usual pain. The big toe joint is slightly enlarged. There is no pain on pressure about the tendo Achillis. The left foot is similar in all respects to the right. Spine painful to pressure along the entire lumbar region, but especially at the junction of the third and fourth vertebræ. Lumbar lordosis is slightly diminished. There is a slight bending of the body to the right. Some pain is referred to the right sciatic region. Hyperextension of the spine is impossible. Bending to the left is restricted more than bending to the right.

Operation.—Incision along the outer border of the os calcis was made. The exostosis was removed, and with it the tissue immediately adjacent. The plantar fascia was adherent to the underlying adipose tissue in places.

Radiograph.—Small exostosis at attachment of flexor brevis digitorum to os calcis. Slight thickening of os calcis. Radiograph of the back shows two exostoses approaching one another between the third and fourth lumbar vertebræ (Figs. 1 and 2).

Bacteriological Report.—Cultures were negative. Plantar fascia showed evidence of an acute inflammatory process, with round-cell infiltration and an increase in blood-vessels. Sections stained for organisms show the presence of a biscuit-shaped coccus, which is the size and shape of the gonococcus.

Result.—Three months after the operation, patient reports that the pain in his heels has entirely disappeared. He is still wearing a spinal support for the arthritis of the back. He is attending to his business for the first time in more than a year.

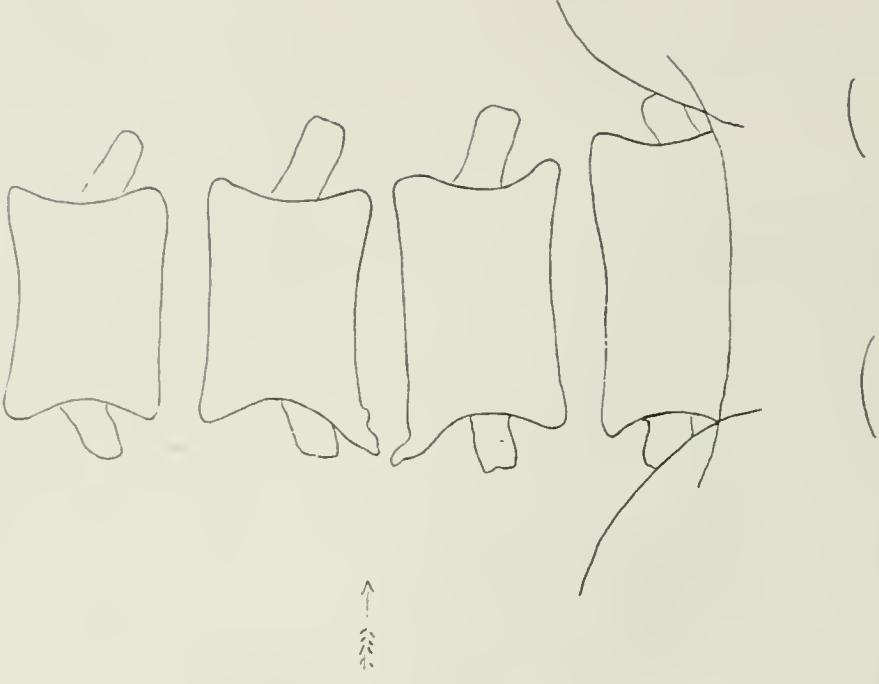
Here we have the production of an exostosis on the inferior surface of the os calcis, which when removed showed the

Fig. 1.



CASE 1.—Gonorrhoal exostosis of os. calcis.

FIG. 2.

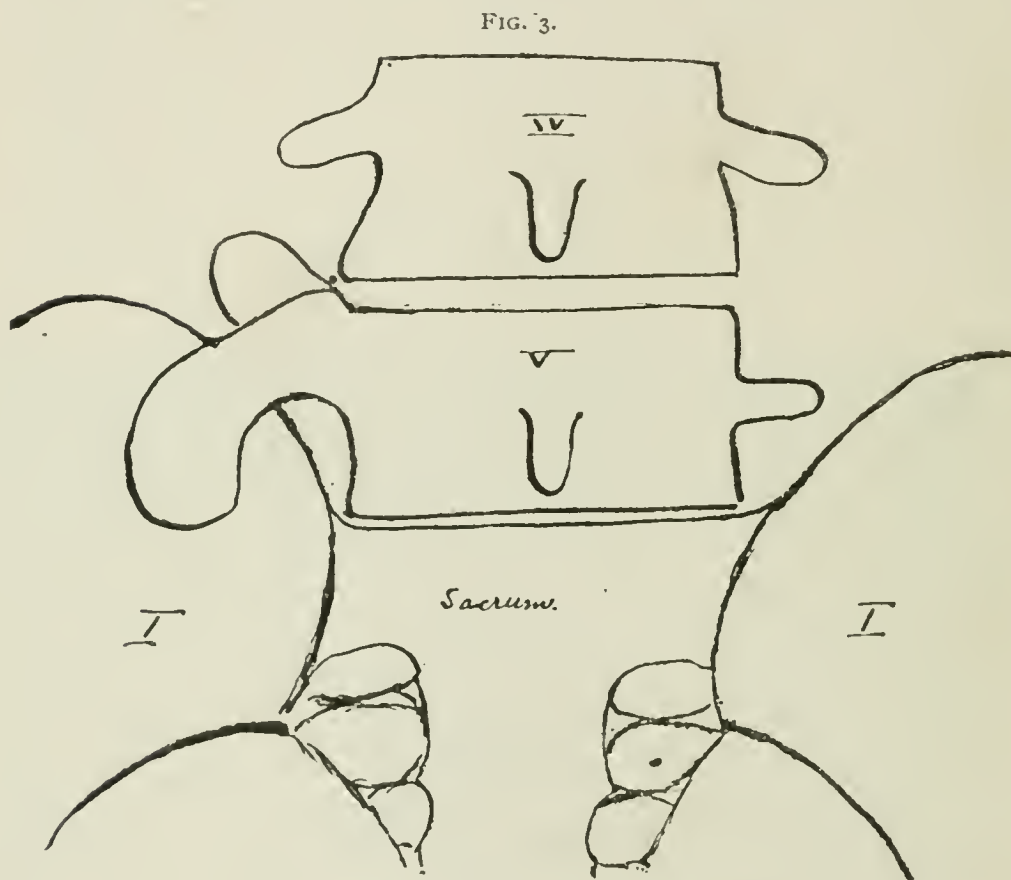


CASE I.—Gonorrheal exostoses of the spine.

presence of the gonococcus in the tissue. The radiograph of the spine shows two prominent exostoses following the course of the lateral ligament. One springs from the inferior border of the third lumbar vertebra, and the other from the superior border of the fourth lumbar vertebra. As the spine undergoes lateral bending it is easily seen how these two exostoses come in contact one with another and produce the pain complained of. As the gonococcus was the organism found in the exostosis of the heel, and as the attack of pain in the back came on shortly following the trouble in the heel it is fair to assume that it was also the etiological factor of the exostosis in the spine. As long as the patient wears a light support which prevents lateral motion in the lumbar region he is perfectly comfortable. As soon as he discontinues its use the pain returns. The rational treatment would be to remove these exostoses in the spine, but as the brace affords perfect relief the patient is loth to undergo further operative measures. Not only a gonococcus can cause such formations upon the spine, but also other organisms, as the tubercle bacillus and the typhoid bacillus, and the cases of both of these infections resulting in changes in the contour of the spine have been reported.

Besides those cases known to be of infectious origin we have the cases of osteoarthritis of the spine. These cases are probably due to metabolic disturbances. They may involve a large area of the column or there may be some localized focus which one can usually remove. They are generally found in the lumbar or cervical region, that is wherever a considerable degree of motion is allowed. Often these cases are associated with other constitutional disturbances, as the presence of gall stones, or of renal calculus. Unfortunately when the new bony deposits have been laid down they do not respond to medication as the two conditions just mentioned. I have brought up the subject to-day in order to show that whatever be the etiological factor in these cases, whether congenital deformities, anatomical variations, traumatism, infectious processes, or metabolic changes, the spinal column is a legitimate

field for operation in certain cases which can be definitely pointed out by means of the radiograph. No other treatment will produce satisfactory and permanent results. In this connection I should like to report two cases where operative treatment was instituted with perfect recovery of the patient. In the case which we will call No. 2 we have the presence of a rudimentary rib springing from the left side of the fifth lumbar vertebra. It passed down into the pelvis, was inti-



CASE II.—X-ray tracing, showing extra rib from 5th lumbar vertebra.

mately bound to the lumbar sacral cord and was the cause of a sciatica which had been so persistent and so severe that the girl had been practically an invalid for the past five years. This rudimentary rib was removed by operation and thereby the pressure on the nerve removed, and since that time she has been perfectly free from pain and goes about as any normal person. The history is as follows:

CASE II.—E. B., white, female; age 22, referred to me by Dr. Thayer on August 22, 1906, and was admitted to the Johns Hopkins Hospital. She complained of sciatica.

Family History.—Negative.

Previous Illness.—There were the usual diseases of childhood, with no acute illness.

The Present Illness.—Duration five years. There was gradual onset with excruciating pain referred along the course of the left sciatic nerve, going down as far as the foot. The pain was so intense that she was confined to her bed for nine months. Later she was able to be about on crutches. There would be periods when the pain was less severe than at other times, but it was always present to a marked degree. The pain became very much worse again seven months ago, since which time she has been practically confined to her bed, the least motion tending to aggravate the condition. All the usual remedies have been applied. The galvanic current has been used without effect. The leg has been packed in ice and also put in extension. Injections of chloroform have been made directly into the sciatic surfaces only to aggravate the trouble. Four years ago the uterus was suspended, thinking that it might possibly be exerting some pressure on the nerve in question.

Physical Examination.—She is rather a thin girl, somewhat anæmic, hæmoglobin being 79 per cent. There is no glandular enlargement. Heart and lungs negative. The abdomen is negative except for some soreness on pressure in the left side of the umbilical region. The patient lies in bed with the leg flexed at 45°. The knee jerks are slightly exaggerated. There is intense pain on pressure over the lower lumbar region on the left side and also over the sciatic nerve as it emerges beneath the gluteus muscle. The pain is elicited on pressure behind the trochanter as well as in the popliteal space. All motions of the leg are carefully guarded. As the patient cannot stand it is impossible to test the flexibility of the spine. There is an atrophy of the thigh of 2 cm. and 1 cm. of the calf.

The Radiograph Examination.—This shows a rudimentary rib about one and three-quarter inches in length springing from the left side of the fifth lumbar vertebra and going down into the pelvis. The rib is of unusual thickness. It articulates with the vertebra in a normal manner. The transverse process is seen pushed somewhat upward (Figs. 3 and 4).

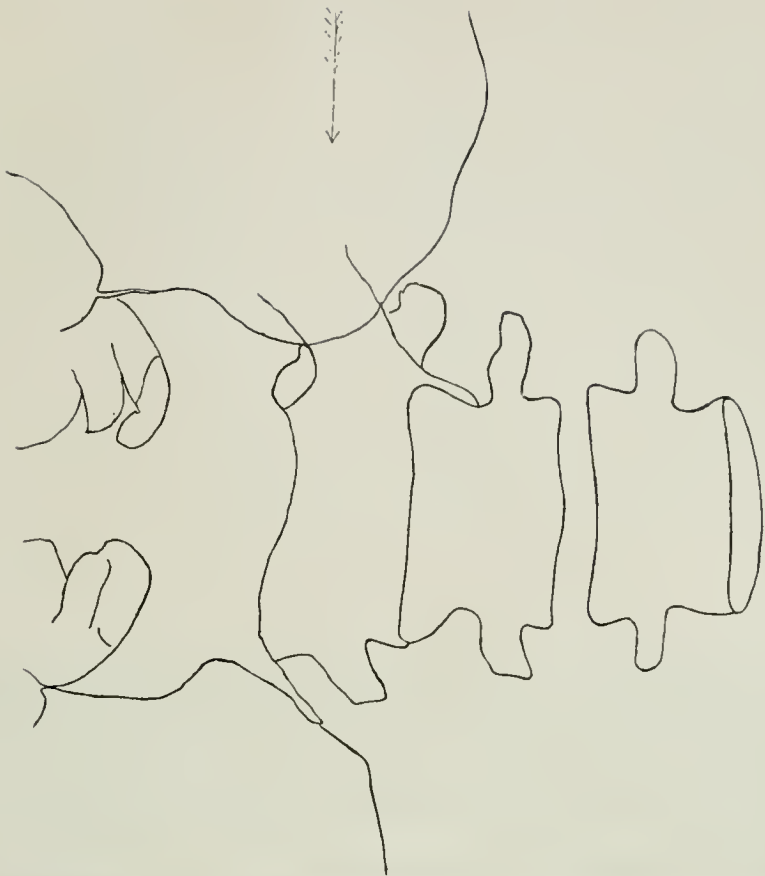
Operation.—The anomaly just described having been pointed out by means of the radiograph and its exact location and dimensions thus being made out, it was decided to operate in order to see whether it did not press directly on the lumbar sacral cord, thus causing the symptoms of sciatica. A vertical incision was made through the skin and fascia along the outer portion of the left lower erector spinæ group. These muscles were retracted inwards, but in order to get a better exposure a slight transverse incision was made into them. The quadratus lumborum was then separated from the erector spinæ group and we came directly down upon the transverse process and the rudimentary rib. One's finger was then inserted under the muscle and the rudimentary rib could be palpated, running down into the pelvis. It appeared to be about $1\frac{1}{2}$ in. or 2 in. long. By probing with the finger within the pelvis the superior portion of the lumbar sacral plexus was found to be closely adherent to the rib along its anterior surface. This was gradually freed with the finger and the rib was excised. The wound was closed entirely, the muscles being sewn with catgut sutures, and the skin with subcutaneous silver wire. A plaster spica was applied. The patient was free from her severe pain almost immediately after the operation, but all of the tenderness did not disappear for three or four weeks. She was able to walk around on a crutch at the end of her third week, and could go about without any support in little more than a month. She is now able to do everything that a normal person can do, and is perfectly free from pain.

The next case, No. 3, is that of a man who had a large exostosis an inch and a half in length extending from the lower border of the third lumbar vertebra and impinging on the side of the fourth lumbar vertebra causing intense pain in the lumbar region.

CASE III.—R. S., male; age 45; admitted to the hospital April, 1906; complains of pain in the lumbar region and radiating into the scrotum. Family history is negative. Previous history of usual children's diseases and gonorrhœa twenty years ago.

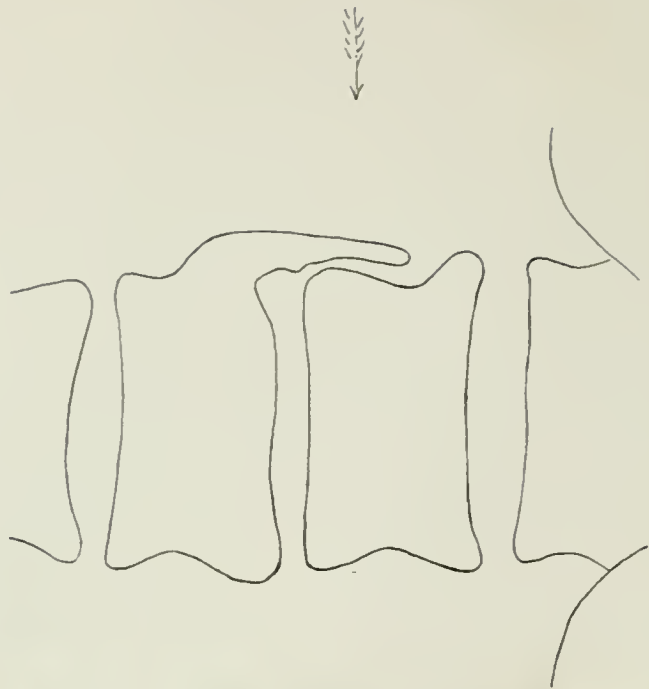
Present Illness.—For the past three years he has had marked pain in the right lumbar region; pain referred down along the right side and also into the scrotum. For the past five months the

FIG. 4.



CASE II.—Rudimentary rib, springing from the fifth lumbar vertebra and extending into the pelvis.

FIG. 5.



CASE III.—Exostosis from the third lumbar vertebra.

symptoms have been more acute, all motion in the lower spine seeming to intensify them, and at times the pain is so severe that he is weakened continually during the night.

Physical Examination.—At the local site of the disease pressure over the lumbar region causes intense pain. Motion of the spine especially in a lateral direction to the right or bending forward or backward is restricted as well as painful. Pain also radiates along the course of the sciatic nerve as far as the knee. The fingers of both hands show a mild grade of Heberden's nodosities. Examination of the ureters shows both to be perfectly patent, but some pus and casts were obtained from the right kidney.

The radiograph shows small calculus in the right kidney and a long finger-like projection of bone about $1\frac{1}{2}$ inches in length, extending along the lower margin of the third lumbar vertebra and passing down along the side of the fourth vertebra. It can easily be seen when one looks at the radiograph how motions are restricted especially as the patient bends toward the right side.

The operation was performed upon the right kidney and a small stone removed. There has been an improvement of the urinary condition and the pain in the scrotum has disappeared. The pain in the back and along the sciatic nerve continued to be so bad that on December 12, 1906, the patient returned for an operation for the removal of the exostosis. This was done by a vertical incision along the outer edge of the right erector spinæ muscle and a small transverse incision into those muscles to afford better exposure. The exostosis shown in the radiograph Fig. 5 was about an inch and a half in length and bound down to the fourth lumbar vertebra by dense adhesions. This exostosis was removed close up to its base. The wound was closed by sewing the muscles together with catgut and the skin with subcutaneous silver wire. Three weeks after the operation the patient was perfectly well, and a letter from him yesterday said that he had had no pain since his operation.

From these three cases we are able to come to certain conclusions—in the first place, that the spine is the seat of numerous affections which differ materially in their etiology.

That these affections simulate the symptoms of other diseases to such an extent that mistakes in diagnosis are fre-

quently made and the patients subjected to therapeutic remedies which cannot be of help to them.

That in cases of persistent sciatica or pain along other nerves a radiograph of the spine should be made to determine whether there is not some point of bony pressure causing the trouble.

That operations on the spine for the removal of these troubles can be made in many cases with perfect ease and safety.

And that operation offers the quickest and most certain mode of treatment in a great majority of such afflictions.

THE SURGERY OF THE THORACIC DUCT.

BY HENRY P. DE FOREST, M.D.,

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THE thoracic duct has, from time to time, been the seat of injury, especially during operations on the neck, and in some instances, attempts have been made for its repair. Such cases are of great surgical rarity, and for this reason contributions to the surgery of the duct, are of professional interest. Rupture of the thoracic duct, as an accompaniment of the gunshot wound of the lung, has thus far been observed but once. It is no wonder that such injuries are rare, since the aorta lies in such close relationship to the duct that death usually occurs at once.

A recent case may be found in the book of Graff and Hildebrandt upon "Wounds Caused by Modern Firearms,"¹ and is there described as follows:

The projectile passed from a point in the region of the apex of the heart, obliquely backward and to the right of the spinal column. Probably the wall of the duct was contused and necrosed, since the first symptoms of leakage developed only after a few days. The diagnosis was then made because of the chylothorax which developed. Several aspirations of the pleural cavity were necessary, and the patient finally recovered. Collateral branches evidently became functionally active, while the main duct which was injured, closed. The chyle ultimately reached the blood current through the newly dilated channel.²

A case in which the thoracic duct was injured during an operation upon the neck, was reported by the writer in his

¹"Die Verwundungen durch die modernen Kriegsfeuerwaffen," by Drs. Graff and Hildebrandt, Berlin, 1907.

²Dietze, "Ueber Chylothorax traumaticus," Deutsche Zeitschrift für Chirurgie, vol. 73, p. 450.

recent article upon "A New Disease of the Thoracic Duct."³ This was contributed by Dr. L. W. Pearson of Brooklyn, and may be summarized as follows:

Mrs. E. K., 45 years of age, suffered from enlarged cervical glands which had existed for about a year. They were most pronounced upon the right side of the neck and the mass extended nearly to the level of the clavicle. An operation was performed April 8, 1905, and the enlarged glands were removed. One gland which had suppurated and the fistulous tract leading to it, were also dissected away, the dissection extending to about an inch above the clavicle. Hemostasis was effected, and the wound was closed. The patient recovered from the anæsthetic and did well. On the fourth day she had one degree of temperature. On this day the dressings were removed. There was no suppuration, but the tissues near the suture line had melted away.

Two days later there was edema of the parts along the line of the incision and adjacent thereto. A probe was inserted at the lower point of the incision and a thick, curdy material began to pour out. As the wound was held wider open, about a pint of this material was evacuated. The wound was irrigated and cleaned, and then it was found that from the lower part of the wound, chyle welled up. This was removed as fast as it was sponged away, and for the next five days, large quantities of chyle escaped more or less continuously. The dressings were saturated and needed frequent changing. Notwithstanding this loss of the products of digestion, there was no especial sense of hunger expressed by the patient, though she was growing somewhat weaker. The temperature varied from 100° to 100.5° and the tissues melted away. At no time was pus present.

On the eleventh day when the dressings were removed for inspection, the flow of chyle seemed to have diminished. The wound was tightly packed with iodoform gauze with hope of its closing. On the next day, the flow of chyle was very slight, on the following day no chyle appeared. The wound itself rapidly closed in from this time forward, and convalescence was uneventful.

By far the most valuable contribution to this subject, however, is the one recently found in the "Festschrift" in honor of the seventieth birthday of Prof. Ernst von Bergmann, and was prepared by Dr. Fritz Lotsch.⁴ It is as follows:

"A wound of the ductus thoracicus at a point near its outlet is an always rare complication of operations upon the left side of the neck."

³ New York State Journal of Medicine, July, 1907.

⁴ Ein Beitrag zur Chirurgie des Ductus thoracicus, by Fritz Lotsch, Surgeon 30th Regiment, Magdeburg Fusiliers, Berlin, 1906.

The first observation recorded upon this subject, was made by von Boegehold in the year 1883. He writes:

“Strangely enough, with the exception of the case observed by me I have never seen a reference to wounds of the thoracic duct in the neck, although with the extirpation of large tumors in this region, such an accident can easily happen.”

Since that time current literature upon this subject has slowly increased from year to year. Unterberger⁵ collected at the end of the year 1905, all of the cases in the Königsberg Surgical Clinic, of operative wounds of the thoracic duct which had occurred and found them to be thirty in number.

Certainly not all cases have been recorded; for instance, in the atlas of Bockenheimer and Frohse it is stated “In spite of all care it will some time occur in the sawing through of the clavicle that the thoracic duct is wounded. It is not necessary to suture it, since a tamponade will, as a rule, remedy the injury.”

It is certain, however, that the wound of the duct, considering the vast amount of material reported, is not an everyday occurrence. The case reported by Dr. Lotsch is as follows:

Mrs. Clara H., aged 30 years; recurrent sarcoma of thyroid gland. Partial resection of gland at primary operation April, 1904. Secondary operation April, 1905.

Transverse incision of the old scar. Extirpation of the individual tumor masses. The left internal jugular vein was ligated.

During the dissection of the nodules in the left supra-clavicular fossa, the deeper portion of the wound suddenly filled with turbid milky fluid, which welled up instantly as soon as it was sponged away. The duct, the size of a straw, was exposed and a cut involving one-third of its circumference was visible. The incision was closed with three fine catgut sutures. The chylorrhea ceased. During further dissection the bulb of the left common jugular vein was exposed and was accidentally torn open. The severe hemorrhage which occurred through this slit-like wound was controlled by a suture of the wall of the vessel. The tumor was finally removed upon both sides, each mass the size of a pigeon's egg. Both surgical triangles of the neck, from the angle of the jaw to the aperture

⁵Unterberger, Ueber operativ Verletzungen des Ductus thoracicus, Beiträge zur klinische Chirurgie, Bd. xlvii, Hft. 3.

of the thorax, were dissected as free as in an anatomical preparation. Gauze drainage. Suture of the wound.

April 13. Temperature continues normal. A marked edema of the left side of the face had developed. Otherwise the patient was in excellent condition. The wound healed per primam. In the drainage opening fresh granulation tissues appeared. The wound being nearly healed, she was permitted to go home.

March, 1907, one year after the second operation, the patient was found to be entirely free from recurrent growth and in excellent health. (This ends the case history.)

This case had to do, therefore, with an oblique wound of the thoracic duct in the supra-clavicular fossa occurring during the extirpation of a firmly adherent secondary nodule of sarcoma.

The severe chylorrhea was controlled by catgut sutures of the wounded duct.

At the present time the therapy of wounds of the thoracic duct has not a firm basis chiefly because of anatomical variations and partly also for physiological reasons. At least from a practical surgical point of view the rules thus far laid down are uncertain.

Even to-day, the conclusions reached by Tholes (1901) are still accepted. "Our knowledge of the exact anatomical relations is still defective and needs the added experience of numerous investigations, such as are given in the works of Boegehold and Wendel. Perhaps it will develop that many conditions now regarded as variations, will prove the normal condition and are the natural safeguards of the body against an occasional wound of such an important structure."

The real question to be considered, therefore, is, Is it possible to ligate with safety the wounded trunk of the thoracic duct in man?

The thoracic duct conveys, as is well known, the finished products of digestion, the chyle, into the blood current and in addition collects the lymph of the entire body, with the exception of the right upper half of the body, whose lymph channels ultimately fuse in the ductus lymphaticus dexter. The current of the chyle is controlled by the movements of respiration. With each inspiration there occurs a temporary negative pressure within the thorax, which sucks the chyle from the

abdominal cavity. Some observers have occasionally discovered that the chyle has a rhythmic motion synchronous with each inspiration very similar to the pulse. (Keen, Cushing, Schroeder-Plummer, Lecène.)

Concerning the course and topography of the extra-thoracic portion of the thoracic duct, the following is a short résumé.

The ductus thoracicus passes on the left side of the œsophagus in the cephalic aperture of the thorax. At the level of the sixth vertebra it turns sometimes in an acute, sometimes in an oblique curve, upward and forward, and terminates in the angle of junction of the left sub-clavian vein with the jugular vein where both of these vessels unite to form the vena anonyma sinistra. Shortly before its termination it receives the lymph duct, coming from the left side of the head and neck (*truncus jugularis sinistra*), as well as that of the left arm (*truncus sub-clavius sinistra*), finally also the *truncus lymphaticus mammarius sinistra*.

At the mouth of the duct in the wall of the vein there are two valves which prevent the flow of blood back into the lymph channel.

It is well recognized how variable and inconstant the course of even the large lymph vessel is, and attention has often been called to the frequent inconstancy in position of veins, arteries and lymph vessels. These variations occur also in the ultimate termination of the great lymph channels, the thoracic duct.

In the present instance we are concerned chiefly with the anomalies in the region of the mouth of the duct. It is important for surgeons to know that the thoracic duct occasionally terminates upon the right side, and that upon the left side in such cases the duct conveys only the lymph from the left upper quadrant of the body into the blood current. Whether these anomalies habitually occur with *situs viscerum inversus* has not yet been determined. Very often anomalies of the blood vessels are present in the same individual.

Of primary importance for the surgeon in treatment of

the wounds of the duct, is the position which the terminal opening occupies in the vein, whether it is in the re-entrant angle or in the jugular or in the sub-clavian vein alone. All possible combinations may occur which can be theoretically imagined. The jugular, sub-clavian and the mammarius veins sometimes have the duct lying close along the wall of the vein; sometimes the ducts of which there may be several are separate and enter the blood current in two or three places. Several anastomoses can sometimes be determined. Not infrequently the duct, after it is joined by the already mentioned lymph channels, divides into a larger or smaller number of fine vessels, sometimes short and sometimes long, which separate or anastomose in several places before they finally enter the wall of the vein. This delta formation is probably the reason why so many variations have been observed. As a rule it is probable when the main channel fills that most of the chyle will pass through it and the smaller ones become so attenuated from inactivity that they escape observation.

In a similar manner may be explained those anomalous lymph channels which have been observed and described in connection with the lymphatic glands of the breast, as they course along the wall of the thorax or of the abdomen. Wutzer, Wendel and Arnold have described communications with the vena azygos; Wendel has observed one with the vena renalis.

When one considers what an important rôle the thoracic duct plays in the function of the entire body, it is little wonder that numerous collateral branches exist to provide against emergencies.

A great many investigators have sought through experiments upon animals to answer the question as to the result in case the thoracic duct was completely occluded. Most of these investigations have been conducted upon dogs. The result in the greater number of cases was merely a temporary impairment of nutrition.

On the other hand, if the duct is cut through without ligating it, there occurs at once the symptoms of a profuse

chylorrhea, which if it be not checked either by accident or by design, will in a short time lead to progressive loss of strength and finally to death.

In the wounds of the duct which have occurred during operations this chylorrhea, strangely enough, often does not develop for some hours and often even days after the lesion has taken place. (Thöle, Schopf, Phelps, Vagedes, Ricard, Wendel, and Halsted.) Probably in these cases there was a narrow slit in the wall of the duct which was temporarily closed, by a small clot of blood or something of that sort.

The tremendous amount of chyle which can escape through the duct which has been opened by accident has been shown in some operative cases, in which efforts to check the chylorrhea did not succeed. (Schwinn, Schroeder-Plummer, Schopf, Ricard and Thöle, whose patient was literally deluged in chyle.)

Especially characteristic in this connection is the case reported by Hahns, in which as a result of an intra-thoracic rupture of the duct nearly 30 litres of chyle were withdrawn by aspiration.

The disease picture which develops as a result of chylorrhea has been observed and described several times (Wendel, Schwinn, Schroeder-Plummer, Schopf, Ricard, Thöle). The digestive organs work in vain. Hunger and appalling thirst develop. Ingestion of food is followed by a marked increase in the chyle which forms and escapes. Emaciation and progressive loss of strength, weakness of the heart action and finally loss of consciousness follow as a result of such a condition. Whether the fever which has been occasionally observed is due to absorption of nucleins and albumins is not certain.

Death, notwithstanding all this, is rather uncommon. The chyle possesses a certain ability to coagulate, yet as a rule, sooner or later the stream of chyle reaches the general circulation through other newly dilated channels.

In many cases after tamponade of the wounded duct, the patient complains of a pressure in the thorax. When the bandage is loosened in such cases, profuse chylorrhea is observed.

More frequently in the first few days after the accident, circumscribed edema occurs in the certain areas. Unterberger describes edema of the left arm; in our own case an edema of the left side of the face was observed which was increased after the ligation of the jugular vein. All these observations seem to indicate that a certain time is needed to establish collateral circulation and to give these non-functionating vessels a chance to dilate. It has never happened, however, that the pressure in the duct in any case is so greatly increased that a rupture of the duct or of one of its radicles has occurred.

The disturbances of circulation which have occurred after operative wounds of the duct have taken place, are as a rule not excessive,—since the pressure of the tumor masses or of the large abscess cavities has already caused a certain development of the collateral branches before the operation takes place.

In the 31 cases observed, 15 were operated on because of malignant tumors (usually metastatic), and 13 because of tubercular adenites. In two (Cheever and Schroeder-Plummer) the character of the tumor is not stated, and in one case (Ferguson) an aneurism of the left sub-clavian artery existed.

In all of these cases there existed conditions which might give rise to marked pressure upon the duct, and therefore it is not possible to exclude the possibility of a more or less collateral circulation. Some observers have described the escape of the chyle in a rather thick stream (Boegehold and Lotsch) of the size of a straw; Schwinn speaks of the size of a knitting needle. Lecène gives a lumen of from 1 to 3 mm.

Two cases of death have occurred in the 31 cases reported in which the thoracic duct has been wounded during the operation (Cheever, Schopf). Lotsch does not agree with most of the writers that one is therefore justified in regarding this as the cause of death. The patient of Cheever died thirty-six hours after a very severe operation as the result of shock. The chyloorrhea was checked by a firm tamponade.

The patient of Schopf dies 16 days after the operation. Autopsy showed an excessive chylothorax on both sides, with a

fibrous pleurisy and pericarditis on the left side, so that death cannot properly be ascribed to the wound of the duct alone.

It therefore follows that the prognosis in wounds of the duct is by no means so bad as it appears to be at first sight. Efforts made to check the chylorrhea in some way or another have nearly always succeeded. In the more unfavorable cases a pronounced loss of strength developed, from which the patient recovered after a long convalescence.

In view of our present knowledge of this subject, are we justified in treating the wound of the duct precisely as we treat those of blood vessels. Several methods are to be considered in this connection.

1. Ligature. 2. Suture. 3. Suture of the enclosing tissues. 4. Application of an artery clamp. 5. Compression by firm tamponade.

The implantation in the vein of a duct which has been cut across (Schopf) is scarcely possible on technical grounds, and has completely failed in satisfactory results.

Of the various methods which have been attempted, the one should be given the preference which with certainty will check the chylorrhea at once. All plans are not of equal value. Ligation or suture upon the one side and tamponade upon the other may be compared with each other. Formerly most operators preferred tamponade, but in more recent years nearly all authorities have recommended ligation. In most cases tamponade has failed to check the chylorrhea immediately. Ligation and suture when properly applied at the place of the injury must of necessity check the flow of chyle. They are therefore the methods to be preferred.

One drawback, however, exists—a technical one. It is often impossible, at the bottom of a funnel-shaped wound, to see the exact site of the injury and to grasp the duct. The nearness of the pleural cavity and of the large blood vessels of the neck, adds a considerable risk, and it is with great difficulty that the duct can be grasped for the proper application of a suitable clamp. In such cases of necessity the tamponade may be used when other methods cannot be applied without great

additional danger. Actual suture at the site of the injury on the wall of the duct, occupies a peculiar place. In many cases occurring during the operation, the surgeon has to deal not with the total division of the duct, but rather with a slit-like opening caused by the firmly attached portions of tumor breaking the wall of the duct during their removal. If it be possible to bring this slit clearly in view, then a suture is technically possible, and the result must be a most satisfactory one.

The wound does not close spontaneously, since the chyle has little tendency to form a clot, and the pressure from within is great enough to keep the wound open. It therefore follows that a suture can be used only in a limited number of cases, and in any case, is not technically easy. It is however to be attempted in this special class of cases, since it is the only means of controlling the leakage from the duct.

In the 30 reported cases, ligature was used 9 times, 6 times with an immediate result. In 2 cases the result was attained only after a certain time (Weischer 8 days, Unterberger 18 days, Schroeder-Plummer (2), Lesniowski (2), Brohl, Thöle, Receni and v. Graff). The case of Ferguson is not included, since the attempts at suture failed. Schroeder-Plummer had to report a complete lack of success in his first case. The ligature was applied when the clamp was removed and immediately the chylorrhea recommenced, a certain indication that the ligature was not properly applied. Tamponade for three months led to a progressive cessation of the chylorrhea. This mischance was not due to the fault in the method, but rather to the imperfect technique.

Suture of the tissue (*Umstechung*) was used in two cases of Wendel and von Schopf, and both cases were successes. In Wendel's case neither tamponade nor clamps nor repeated tissue suture succeeded in checking the chylorrhea. Suture gave only temporary benefit. Finally the use of a firm tamponade held in place for five weeks. Clamps applied for a considerable time were used in this case.

Phelps and Schwimm could not ligate the duct because of the depth of the wound. A clamp was applied and left in

place for three days; this succeeded in terminating the chylorrhea. In Wendel's case two clamps were applied. Chylorrhea ceased on the fourth day. In three cases the method failed and tamponade was then applied.

In 13 cases a tamponade was used; in 6 the flow was controlled at once. In Ricard's case the wound was dressed upon the sixth day and then for the first time a collection of milky fluid was observed. This is very similar to the case of Pearson. This was first thought to be pus, and only after 14 days was a tamponade applied. In the remaining cases chylorrhea ceased after a variable time (from five days to five weeks). Both cases which died (Cheever and Schopf v. s.) were treated by means of tamponade.

CONCLUSIONS.

1. The thoracic duct probably has collateral branches always which are able, in case of accident, to perform the function of the main duct. Further anatomical investigations concerning this are greatly to be desired.

2. The sudden closure of the duct in man has had as its result only transitory disturbance in the nutrition of the body.

3. Chylorrhea occurring after a wound of the duct, must, if possible, be immediately controlled.

4. The wounded thoracic duct may be treated precisely as we would treat a wounded blood vessel.

5. Suture is the ideal method. If it is technically possible, its use is to be preferred, since the duct then remains patent.

6. In all cases in which suture can be performed, a ligature should be applied. If ligature is technically impossible then in order of value, suture of the tissue (*Umstechung*), application of clamps, and in emergency, as a last resort, tamponading should be applied.

NOTE: *Bibliography*.—A complete bibliography of the subject will be found appended to the memoirs of *v. Graff*, *Zur Therapie der operativen Verletzungen des Ductus thoracicus*, *Weiner klin., Wochenschr.* 1905, Nr. 1, and *Unterberger*, *Ueber operative Verletzungen des Ductus thoracicus*, *Beiträge zur klin. Chirurgie*. Bd. 47, Heft 3.

DERMOID CYST OF THE HEAD.

EXCISION, USING CRILE'S TEMPORARY CLAMP ON THE COMMON CAROTID.

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THE situation of dermoid tumors usually follows certain definite lines, as Mr. Bland-Sutton has pointed out. The vast majority of these growths are found either in the abdomen, especially in connection with the ovary, or else about the embryonic fissures. Those fissures which, when closing, separate a mucous from a cutaneous surface, are especially prone to be the seat of dermoids. Thus, it is not uncommon to find them about the coccyx, where the posterior fissure closes, and about the eyes, springing from the orbito-nasal fissure. The lower part of the nose, the middle of the upper lip, and the outer angles of the mouth are regions where dermoids of the face arise because of the previous existence of fissures at these points. The floor of the mouth, resulting from the closure of the intermandibular fissure, is not an infrequent region for these cysts, and here they are often confused with retention cysts. The resemblance of these two classes of cysts is all the more confusing when the dermoid is derived from the implantation of an early matrix before the more complex epithelial elements have formed. In such instances, the contents may be of a mucous character, resulting from the degeneration of the lining epithelium of the dermoid, and consequently be almost identical with the contents of retention cysts found in this neighborhood. If, however, the matrix from which the dermoid arises is of a later stage of development when such structures as hair or teeth may arise from it, the differential diagnosis is clear. Dermoids in the neck are usually derived from inclusion of a matrix from the branchial clefts.

It has been generally believed that the ovary is the most

FIG. 1



Dermoid cyst of head. Photograph taken a few days before operation.

trequent site of dermoid cysts. This is due to the fact that such tumors of the ovary often attain large size and, consequently, are reported more frequently than the smaller and more insignificant dermoids in other regions of the body. Then, too, the dermoid of the ovary often contains other elements than those of epithelial origin, which makes the tumor of a more sensational character and, therefore, more likely to be reported. For instance, cartilage and bone showing a mixed matrix are often found, whereas dermoids of the subcutaneous areas are almost always of a pure epithelial origin.

The following case is reported because the dermoid was in an unusual location, apparently springing from the temporal fossa, and because it is an exceptionally large one for this region. Senn says that with the exception of the ovary, "dermoid tumors larger than a hen's egg are rare." From an operative standpoint some interest may attach to the effect of temporarily clamping the common carotid—a method recommended by Crile. The absence of injury to the artery is shown quite clearly in the specimen which consists of the common carotid and the first portions of the internal and external carotids.

The patient was a negro man, forty years of age, of a rather low degree of intelligence. His previous history was vague, but from what could be gathered he seemed to be in good health until two years before admission to the hospital, though he had never been very robust. About two years before the present operation the left side of his lower jaw was fractured as the result of an accident. This was followed by some tumor formation, as well as I can gather from his history, and as a result the left portion of his lower jaw was excised by another surgeon. Soon after this operation he noticed a growth beginning on the left side of his face, apparently involving the upper jaw. Later the tumor grew more rapidly, and became quite painful, the pain being due, apparently, to pressure upon branches of the fifth nerve. His appearance on admission to the hospital, January 2, 1907, is well represented by the accompanying photograph (Fig. 1). There was no paralysis of the seventh nerve, and no paralysis of sensation. Certain portions of the tumor presented a bony consistency

and over other portions distinct fluctuation could be obtained. The hard area of the tumor corresponded to about the region of the malar bone, and was later shown to be due to the fact that this bone and the adjacent portions of other bones were attached to the wall of the cyst and had been pushed forward and outward by the growth of the tumor. The part that showed fluctuation was where the cyst wall was covered merely by skin and subcutaneous soft tissue. The patient was considerably reduced in strength and weight, and suffered neuralgic pains from pressure almost constantly. On admission his pulse was 80, temperature 98.4, respirations 18, urine normal. He had considerable difficulty in chewing owing to the previous removal of part of his lower jaw, and also because of the tumor. He was given tonics and soft diet and every effort was made to build him up. The nose and throat were sprayed with an antiseptic solution several times a day and the mouth cleaned after feedings.

On January 8, 1907, I operated upon him at the clinic under ether narcosis. A hypodermic of morphine and atropine was given before the anæsthetic was started. An incision over the anterior lower portion of the sternomastoid muscle exposed the common carotid, which was clamped with Crile's clamp, both blades of which had been covered with rubber tubing. The skin over the most prominent area of the growth appeared moderately adherent, so the incisions were fashioned in such a manner as to leave this part of the skin attached to the tumor, as it was thought at the time that the tumor was a sarcoma. A long incision, starting behind and above the outer angle of the orbit, swept down somewhat posterior to the most prominent portion of the tumor, and curved forward underneath the jaw. Another incision, connecting the horizontal and vertical portions of the first cut, left an island of skin over the most prominent part. The upper part of the tumor was then exposed, and the outer wall of the orbit cut through with bone forceps. The lower wall of the orbit, the superior maxilla near the alveolar process, and the zygoma near the temporal bone were similarly cut and the lower and outer portion of the wall of the orbit, including all of the malar and part of the superior maxilla, was removed with the growth. By dissecting from above downward and keeping as far from the capsule of the tumor as possible it was excised intact. Particular care was taken to avoid rupturing the cyst. As the

FIG. 2.



The interior of the common and internal carotid arteries. The Crile clamp had been applied about point "A." Note entire absence of injury to the intima. The few shreds of fibrin, found in all large arteries after death, have not been removed.

FIG. 3.



Lateral view, showing the external carotid, which has been split to the ligature, still containing part of a clot.

patient had been placed with his body and head in a semi-sitting position but little blood was lost from oozing, and the temporary clamp on the common carotid controlled arterial bleeding perfectly. Not more than an ounce and a half of blood was lost at the operation. When the growth was removed the external carotid was ligated near its origin, as on account of the bony surfaces left it would not have been practicable to control the terminal vessels from this artery by ligatures. The clamp was removed from the common carotid and the wound sutured. The patient suffered somewhat from shock, but an hour after returning from the operating room his temperature was 98.3, pulse 100. His condition the following day was satisfactory, except that deglutition was rendered painful and more difficult by reason of the extensive operation. Anticipating the possibility of pneumonia, a pneumonia jacket was applied and the nose and mouth frequently sprayed with antiseptic solutions. During the first forty-eight hours after operation he vomited a few times. On January 10th, his temperature reached 101, the highest point up to that time since the operation. His pulse was 120 and respirations 32. Examination showed beginning pneumonia, and the patient was referred to Dr. M. Call, Professor of Medicine in the Medical College of Virginia. The respirations and pulse increased in rapidity until a few hours before his death, when the pulse was 162 and respirations 52, with a temperature of 102. He died about nine P.M. on January 14th.

The post-mortem held by Dr. Call a few hours after death showed consolidation of practically all of the lower lobe of his right lung and portions of the upper and middle lobes. There were old pleuritic adhesions on the right side. Death was due to pneumonia. The wound was in excellent condition, and had healed by first intention throughout most of its extent. There was no suppuration at any point. Most of the trunk of the common carotid with portions of the internal and external carotid arteries was removed in one specimen. The common carotid showed no injury at the point where the clamp had been applied (Fig. 2). The lumen of the internal carotid was free, as was also that of the external carotid up to the ligature. On the distal side of the ligature a clot filled the lumen of the external carotid for about half an inch. The condition of the arteries is shown in the accompanying photographs (Figs. 3 and 4).

I am greatly indebted to Dr. Joseph Bloodgood, of Baltimore, for the following report:

" March 10, 1907.

"*Pathology*: P. No. 8007, *Gross*.—The specimen consists of a cystic tumor of the peculiar shape shown in the photographs (Figs. 5 and 6). It measures about 6 inches in length by 3 inches by 4 inches. Over one side there is an elliptical piece of skin 4 inches by $1\frac{3}{4}$ inches. On another side is a flat piece of bone $2\frac{1}{2}$ inches by $2\frac{1}{2}$ inches in surface diameters. The bone, however, is exposed in only one area, which suggests the inferior orbital ridge of the superior maxillary bone. The remainder of the bone is covered with muscle, subcutaneous tissue and fat, as if it represented the anterior wall of the antrum. Attached to the cyst wall are pieces of fat, muscle and connective tissue. The cyst wall can be stripped from the piece of bone and leaves it denuded of its periosteum. On opening the cyst, it contained a thick, brown fluid, quite granular and of the appearance of contents of a dermoid into which there has been some hemorrhage. When this contents is washed out, in one or two places the granular masses of the contents stick to the smooth cyst wall within. The wall in some places is gray in color, in others stained brown with blood. It looks like epithelium-lined tissue. On section it is composed of a dense membrane not more than 1 mm. in thickness. Beyond this membrane in some places there is no other tissue, it is adherent to the bone over the piece described, while in the remainder there is muscle beyond.

"Path. No. 8007. Microscopic study:

"Section 2. Thin cyst wall. Section shows fibrous connective tissue in lamellæ. On the cyst side the connective tissue is much more compact and on the surface in the first layer of connective tissue there are numerous spindle nuclei suggesting the basement membrane beneath an epithelial lined surface but no epithelium is to be seen. Beneath this there is some pigment. In the wall further from the surface there are numerous round and spindle nuclei in the fibrous connective tissue and here and there small areas of lymphoid cells. Deeper there is the remains of a striated muscle undergoing pressure atrophy. There are very few blood vessels and no giant cells. We have the usual picture of connective tissue wall of the cyst, but the epithelial lining quite often found in the dermoid is not present. Here and there are large vessels filled with blood cut both longitudinally and across. As the cellular areas are most marked where we find remains of muscle they suggest the indication of an interstitial myositis from pressure. The round, spindle and lymphoid cells are found also in the region of vessels.

"Section 1. The thicker portion of the wall including muscle. We have the same picture seen in section 2, but no epithelial lining. Beyond this muscle it is almost completely replaced by fibrous tissue, with here and there a blood vessel surrounded by lymphoid cells."

FIG. 4.



Lateral view, showing ligature on the external carotid.

FIG. 5.



Anterior surface of the tumor. Note near the bony end a portion of the island of skin left attached to the tumor; near the upper end part of the bony wall of the orbit.

FIG. 6.



Internal surface of the tumor.

STYLO-HYOID OSSIFICATION.

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“*Observavi tamen aliquando processum styloideum usque ad cornua ossis hyoidei pervenire, ipsisque valido nexû devinci.*” *de Marchettis*. Anatomia. Patavii, 1652, cap. xiii, p. 205. Probably the earliest reference to this condition.

Although the occasional recurrence of ossification of the second branchial bar, represented by the styloid process, the stylo-hyoid ligament and the lesser horn of the hyoid, has been repeatedly observed in man, yet the number of well described cases is very small. Le Double in his work on the variations of the facial bones finds only some twenty instances of which one or two have never been published and of which others are very inaccessible. This condition has most frequently been recognized in the living by laryngologists, but it may be said that its clinical importance has not been generally appreciated. It appears, moreover, that there is even among anatomists more or less misunderstanding as to what has actually occurred in these cases, and that the nomenclature of the parts involved is very confusing.

This subject has been particularly brought to my attention by the observation of a very perfect case of ossification of practically the whole chain on both sides in a dissecting room subject. Moreover, the peculiarity was discovered before the dissection was very far advanced so that it was possible to have the body X-rayed before the relations which existed in life had been very seriously changed. At almost the same time two extremely long styloid processes, reaching nearly to the hyoid, were observed on another subject which was also X-rayed. So far as I am aware these skiagraphs are the first that have been made of this condition.

In this paper I propose (I) to describe the composition

of the stylo-hyoid chain and to show what occurs in ossification of the chain or of parts of it; (II) to describe cases of extensive ossification of my own observation, and others in the Warren Museum of the Harvard Medical School, and then to mention the peculiarities of a number of other specimens found in literature; and (III) to refer to the clinical importance of this condition.

I.

The Stylo-hyoid Chain.—The second branchial bar or the cartilage of Reichert, extends in early embryonic life downwards and forwards from the skull to meet its fellow to which it is connected by a cross piece the *basi-hyal* which becomes the body of the hyoid. The chain of pieces with which we have to deal does not include the basi-hyal. It consists of four elements. (1) The *tympano-hyal* extending from beside the periotic capsule, which later is enclosed in the petrous portion of the temporal bone, to the lower surface of that bone or a little beyond it. The late Professor Flower was, we believe, the first to suggest the name we have used for this element. French writers call it *le prolongement hyoïdien*. (2) The *stylo-hyal*, which usually forms the greater part of the styloid process: (3) The *cerato-hyal* which is usually represented in the adult by the stylo-hyoid ligament, or by an ossification in the same, and (4) The *hypo-hyal* which becomes the lesser horn of the hyoid. There is unfortunately more or less confusion in the nomenclature. Some writers call the cerato-hyal the lesser horn and some use the term *epi-hyal*, which we have avoided altogether, for diverse elements. Some parts of this cartilaginous chain become bone by the normal process of ossification, but other parts degenerate into fibrous tissue. Before considering the remarkable cases of extraordinary ossification, something should be said of the usual course of events and of minor modifications.

Let us examine very briefly these different parts of the stylo-hyoid chain in a little more detail. First: what constitutes the normal styloid process? There is a very confusing

discrepancy of opinions. The soundest view is that according to which it consists of the tympano-hyal and the stylo-hyal. Normally the tympano-hyal projects but very slightly beyond the temporal and shows a rough circular end which is connected with the next piece by cartilage or perhaps by fibrous tissue during adolescence and sometimes for a much longer period. Ultimately it fuses with the styloid which is thus joined to the skull. Yet I have seen a skull said in the catalogue to be of a child of eight, but which I should call some four years older, with the tympano-hyal projecting a centimetre or more from the base and joined to a second piece by a jagged line of union. In several of the anomalies to be described later the tympano-hyal projects considerably.

Sappey, following in the main Geoffroy-Saint-Hilaire, who was the first of modern authors to write on the hyoid chain, makes the styloid process consist of the first and second pieces, but he adds that the cerato-hyal ossifies before the stylo-hyal. In his diagram of what is normal he figures a free ossification in the cerato-hyal. He believes that this fuses with the tympano-hyal and the other where it fuses with the cerato-hyal. The theory that the fusion of the cerato-hyal with the stylo-hyal forms the tip of the styloid is very hard to determine; but it is a plausible explanation of instances when the point of the styloid, especially of a long styloid, joins the shaft at an angle.

Sappey seems to be alone in supposing that the cerato-hyal ossifies before the stylo-hyal. For our part we believe that it is quite exceptional for the cerato-hyal to ossify at all, although sometimes it presents a long slender ossification. It is possible enough that the upper end of this may join the styloid but we do not believe that this is the usual process. The lower end of this ossification may join the hypo-hyal thus making a very long lesser horn. Finally the normal ligament may be absent altogether, the original cartilage having disappeared and left no trace.

The hypo-hyal or lesser horn normally persists as an elongated cartilaginous nodule which is connected to the hyoid

by a ligament or by a true joint, and which late in life may be joined to it by bone. Sometimes, indeed, this bony union occurs very soon. The usually small nodule may be long and even double. It may fuse with the cerato-hyal. On the other hand it may be represented by fibres forming the lower part of the stylo-hyoid ligament, in which case the lesser horn is said to be wanting; and finally as in the cases just referred to, there may be not even a ligament. Thus it appears that the process of development presents a great number of individual variations and moreover that the same, or at least a similar, result may be reached by different processes. Thus the styloid need not always be composed of the same pieces, and the lesser horns may be elongated either by uncommonly large hypo-hyals or by their fusion with an ossification in the cerato-hyal.

A most important point in the consideration of cases of almost total ossification of the chain is that this is not to be considered a degenerative change, depending on age. That this idea was formerly held can be shown by quotations from eminent anatomists. Thus Gruber wrote: "Should the stylo-hyoid ligament become ossified throughout its length and also in rare cases among old people become joined with the styloid process, then the last will reach from the skull to the hyoid as was first observed by de Marchettis and after him by others and myself." Sappey alludes to the ossified cerato-hyals joining the styloids at from fifty to sixty and adds that the styloid process then takes on what he calls a "monumental" appearance twisted and knobbed, which characterizes it in some individuals. Though we believe the joining at that age to be entirely imaginary we quote the passage as showing the existence of the idea that these things come with advancing years.

Debierre, I believe, was the first to protest against this view. He writes, "Mais il ne faut point dire, avec nombre d'anatomistes, que dans certains cas le ligament stylo-hyoidien s'ossifie. Ce n'est pas ainsi que se rétablit la chaîne hyoïdienne osseuse." Peter who studied a large series of hyoids says

of the instances of remarkably long lesser horns that five of the most striking cases occurred in persons of from fourteen to twenty-five years. Le Double insists that it is to be considered a theriomorphic manifestation.

The facts are these. It is perfectly true that in certain cases cartilaginous and fibrous tissues degenerate by the deposit of earthy salts into what may be called bone. Although most likely to occur in old age, yet it not rarely occurs early and is apparently to be attributed to constitutional causes.

In point of fact these cases are due chiefly (if not in all details) to the persistence of the embryological cartilage, to its growth to an abnormal size and to its final conversion into bone. This last is not a degeneration of tissue but the normal process as it occurs among animals in general. This is made very striking in most of these cases by the large size of parts of the hyoid chain which could not be explained by the degeneration of ligament. It is very probable also that in some cases in which the bony rod is slender the cartilage has persisted and become bone, because this is more likely than that fibrous tissue should have ossified at that age; but in the former cases the bar of bone is so large that one can only account for it by supposing that the original cartilage continued to grow and then underwent ossification. In these cases the rod is not one continuous piece but is made of several segments which generally present enlargements at their points of junction. The joints between these pieces have not received very satisfactory description. The fact is that they apparently are not true joints at all, but that the still cartilaginous ends of the pieces play one on another within the enveloping fibrous tissue which is continuous with the periosteum. The apposed ends of the bones have the appearance of having been connected by cartilage, and ultimately they become ankylosed to a greater or less extent, which indeed is an ultimate degeneration. Other instances of senile degeneration which has attacked the already abnormal structure will be alluded to in the account of the cases.

II.

Description of Cases.—I shall now describe three recent specimens of my own observation, then two more also in the Warren Museum of the Harvard Medical School which have never been described at length, after which I shall give a short account of several cases recorded in literature, and then give a short summary of the results of the study.

SPECIMENS IN THE WARREN MUSEUM.

CASE 1 (Figs. 1 and 2).—White, male, old. The chain of bones consists on each side of three pieces besides the lesser horn, which on the right is very small and ill defined, lying in the mass of fibrous tissue which passes from the piece above it to the hyoid. On the left it is represented by two nodules, one above the other. The first piece on both sides measures 2 cm. and is enlarged at the lower end, which is movably attached to the second piece, which measures 4 cm. on both sides. Its lower end is also slightly enlarged. It is movably attached on the right; but on the left is fused with the third piece, which is directed strongly forward on either side so as to be approximately parallel with the great horns of the hyoid. This third piece measures 2.9 cm. on the right and only 1.5 cm. on the left. On the right it is continued to the hyoid by a ligament only some 3 mm. long, which encloses the rudimentary lesser horn. On the left the two nodules are enclosed in a ligament of some 7 mm. The largest diameter is about 6 mm. near the lower end of the first piece on the left. Although certain joints were noted, they disappeared when the specimen was dried. It may be considered practically certain that there was no motion of any importance between the different pieces, excepting in the neighborhood of the hyoid. This peculiarity was happily discovered during the dissection before very much had been removed, so that the subject still had the outlines of a human body rather than those of an anatomical preparation. The X-ray reproduced in fig. 2 was taken as soon as possible. It is, so far as I know, the first of its kind.

CASE 2 (Figs. 3, 4 and 5).—The next case was observed at about the same time. H. 402. Male, black, age unknown but young, apparently about twenty-five. This may be called an instance of very long styloid processes. It was noted during the dissection that they seemed to reach to within one or two centimetres of the hyoid. No stylo-hyoid ligament and no lesser horns could be found. The length is 5.9 cm. on the right and 5.3 cm. on the left; but measurements must often be only approximate from the difficulty of getting a really satisfactory and precise starting point. The condition is quite different on the two sides. On the right the tympano-hyal projects but very little beyond the vaginal process. It is connected by fibrous tissue to a long, slender rod, presenting something of an enlargement at its middle, which marks a change of direction. At first

it runs forward and downward and then inclines inward as well. There is another bend just before the point. On the left the process is much straighter. The tympano-hyal, which is much stronger than on the right, projects far beyond the vaginal process. It is connected by fibrous tissue with the stylo-hyal, which runs downward and forward without change of direction except for a slight bend backward at the end. The tympano-hyal has a very much greater development on the left than on the right, illustrating beautifully the principle that in such variations the same element may be of very varying importance. It is not unlikely that the point on both sides is made by the cerato-hyal, but there is no way of knowing and it is of no consequence. An X-ray was taken of this head also before the dissection was very far advanced. These two cases were seen near the close of 1906.

CASE 3 (Fig. 6)...No. 9993. Male, black, age 28. This specimen was found in the dissecting room a few years ago, during my administration, and was placed by me in the Museum. There is nothing very remarkable about the styloid processes. The feature is the strong ossification of the lower part of the chain; and again the condition is not the same on opposite sides. The arrangement on the right is as follows: the tympano-hyal is not to be distinguished, the stylo-hyal is ligamentous, 2.6 cm. in length, the cerato-hyal is bone. The length is 4 cm. and the greatest breadth, which is at the top, 5 mm. A ligament 4 mm. long connects the lower end of this ossification with the hyoid. There is no lesser horn.

On the left the tympano-hyal projects just beyond the vaginal process. Next to this comes a ligament 5 mm. long, then an ossification, the stylo-hyal 1.3 cm., which is connected by a ligament 3.1 cm. long to the cerato-hyal, which measures 2.8 cm. and is not only much shorter but much lighter than its fellow. The most important difference is at the lower end of the chain. On the left a lesser horn of 4 mm. springs from the hyoid and is connected by a very little fibrous tissue with the lower end of the cerato-hyal.

The two next cases have been for years in the Warren Museum.

CASE 4 (Fig. 7).—No. 6631. Sex, age and race are not given, but I have very little hesitation in pronouncing it male and I incline to think it is the head of a negro. The right stylo-hyal is a thick rod which about 1.6 cm. from its origin expands into a rounded knob. The shaft is thickest in a line running backwards and outwards, measuring 8.5 mm. The transverse diameter is 4.5 mm. Continuous with the thick rod, which has been assumed to be an elongated stylo-hyal, is a long, slender bony process, extending in a somewhat tortuous course downwards and forwards. This apparently was sawn across before it was observed in the dissection. Apart from this obviously artificial division, the bony rod extends 7.7 cm. from the skull (measured in a straight line), ending in a small knob. There is, of course, no means of knowing how this rod was connected with the

hyoid. The attachment shown in the photograph is entirely artificial. There is no lesser horn on either side.

On the left the tympano-hyal projects beyond the vaginal process. It is of about the usual size and has a rough ending as if it had once been covered with non-articular cartilage. This specimen is remarkable for the very large size of the upper part of the rod as well as for its length.

CASE 5 (Fig. 8).—No. 602 was placed in the Museum by Dr. David W. Cheever in 1865 during his service as Demonstrator. There is no statement of age, sex nor color. The chief interest is that the chain differs from all the others. It probably did not come from an aged individual, as the greater horns of the hyoid apparently are not fused with the body. Owing in part to the method of mounting it is very hard to determine whether there is any element that can be called a tympano-hyal. The stylo-hyal is longer on the right and thicker on the left. The cerato-hyal is of about the same length on both sides, but is separated from the preceding piece by a longer ligament on the right than on the left. This condition is reversed below this ossification, the ligament going to the lesser horn being longer on the left. These horns measure each 3 mm. and are fused with the greater horns. Thus there is a general correspondence between the two sides with a difference in details.

Passing now to cases recorded in literature and without making any attempt at a complete account of all cases observed I give several which strike me as the most interesting and which illustrate the variety of details presented by this abnormal ossification.

CASE 6.—GEOFFROY-SAINT-HILAIRE describes a specimen given him by Serres. The body of the hyoid bone was very large, somewhat resembling that of American monkeys. The greater horns were slender and very wide spread. The first piece of the chain, which he calls the styloid, was long and thick, while the cerato-hyal and the apo-hyal (hypo-hyal) were slender, long and straight and swollen at their ends. The last mentioned was longer by a quarter than the one above it. These two appeared to have been but recently united together, and the same is true of the first piece and the vaginal process, although the man was fifty-six years old. Ligamentous fibres connected the lesser horns with the body of the hyoid. This condition was found only on the right.

The following three cases reported by the late Professor Saturnin Thomas, of Tours, are taken from the paper by Retterer.

CASE 7.—Male, aged thirty. There was a swelling below the vaginal process at the junction of the tympano-hyal (*prolongement hyoidien*)

FIG. 1.



CASE I.

FIG. 2.



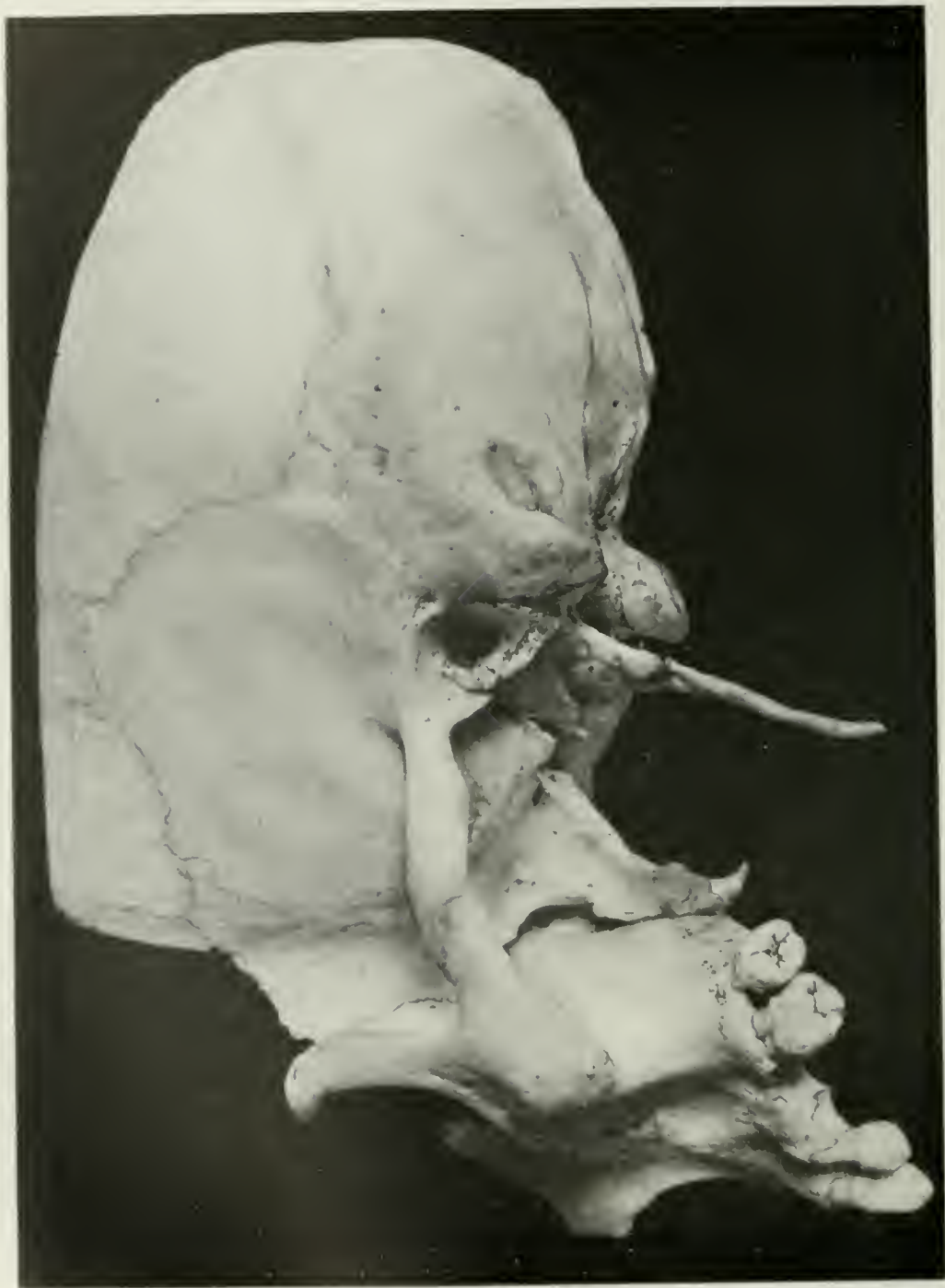
An X-ray of Case I when only partially dissected. The stylo-hyoid chain of one side is shown clearly.

FIG. 3.



CASE II.—Right side. The tympano-hyal does not project beyond the vaginal process. The styloid process, which is not joined to it by bone, probably consists of the stylo-hyal and cerato-hyal.

FIG. 4.



CASE II.—Left side. The strong tympano-hyal is very prominent. There is no bony union between it and the stylo-hyal.

FIG. 5.



An X-ray of Case II when only partially dissected and before the skull had been divided.
Both stylo-hyoid chains are shown.

FIG. 6.



CASE III.—The lower part of the cerato-hyal is a strong bony rod on both sides.

FIG. 7.



CASE IV.—The large first piece is probably an immense tympano-hyal, with which the fused stylo-hyal and cerato-hyal are united.

FIG. 8



CASE V.—The ossification is irregular and asymmetrical.

with the styloid. The lower end of the latter articulated with the cerato-hyal, which was continued by ligament to the hypo-hyal or lesser horn.

CASE 8.—The vaginal process was continuous with the tympano-hyal, of which the lower end was fused with the first piece of the stylo-hyal, which had a fusion at its junction with the cerato-hyal.

CASE 9.—Female, aged fifty. The lesser horn was elongated as in animals. The cerato-hyal was very small and not joined to the piece above it.

No mention is made in the abstract by Retterer as to whether these conditions existed on one or both sides.

CASE 10.—SAPPEY in the third and fourth editions of his Anatomy gives a fine illustration but no description of a case of this kind. Perhaps it is the often mentioned one in the Musée Orfila. Describing it from the drawing, it appears to be essentially symmetrical on both sides. The tympano-hyal projects some distance beyond the vaginal process and ends in an enlargement which meets a similar enlargement of the stylo-hyal. This is the largest point of the bony chain. Below this comes the cerato-hyal, which is connected to the lesser horn by ligament. The drawing represents it as completely fused with the stylo-hyal on the left. In spite of the author's use of the word "*soudure*," the other above mentioned joints would appear from the drawing to persist.

CASE 11.—GRUBER reports an instance of ossification on both sides in an old person, which apparently was observed on a macerated skull. The hyoid apparently had been lost, but the bony rods were so long and came so near together below that one cannot doubt they very nearly reached that bone. The drawing represents them ending in sharp points, which we are told were 11 or 12 lines (say an inch) apart. The two rods were equally long and showed occasional swellings. The left one was rather stronger than the right. Both had a bend near the middle, that in the right one being the greater. The part above the bend was slightly curved on both sides and the lower portion straight.

CASE 12.—POIRIER and MEUNIER had a remarkable case of very perfect ossification of this ligament from a person, sex not stated, of thirty years. The greater horns of the hyoid were remarkable for their size and for the presence of a small nodule at their ends, connected with them by some kind of a joint. The stylo-hyoid ossifications of the two sides were practically symmetrical. They presented the following pieces: the styloid process, a long piece divided into two, showing a swelling and remnant of a suture at the junction of the first and second third; then the little horn of the hyoid, surrounded by fibrous tissue, connecting it both with the last mentioned bone above, and with the hyoid below.

CASE 13.—The following case from a man of sixty-four, reported by MEUNIER is in one respect unique;¹ namely, that the hyoid bone and the (ossified) thyroid cartilage were united. The ends of the greater horns of

¹ This is unique among variations of this class, but Debierre describes a hyoid which had true joints on the under side of the ends of the greater horns to articulate with the tips of the thyroid horns.

the hyoid were connected with the superior horns of the thyroid by joints which apparently once had been true joints. On the right, indeed, the joint was quite lost, being represented merely by a swelling. On the left the joint still existed, but in such a condition that there was no motion on either side. The hyoid in this case was peculiar. The body was large and deeply hollowed. Moreover it was surmounted in the middle by a tubercle projecting towards the muscles of the tongue suggestive of the *uro-hyal* of mammals. The stylo-hyoid chains were not symmetrical. The right one was slender and nearly straight. It consisted of the stylo-hyal, the epi-hyal, which was a small nodule in the ligament from the stylo-hyal, to another long piece which represented the cerato-hyal and the hypo-hyal. A swelling at the lower third marked the point of their union. The left chain was larger and more tortuous. First there was the stylo-hyal joined by a fibrous sheath to a long second piece, 5 mm. thick, which represents both the epi-hyal and the cerato-hyal. The point of union is marked by a swelling at the upper third. This compound second piece ended below in a swelling which rested on the outer end of the body of the hyoid, but leaving room between it and the greater horn for the presence of a detached nodule as large as a pea, which is the hypo-hyal. I infer that the chains were continuous with the temporal bones, but this point is not stated as clearly as could be wished. On the right there was some play between the first and second pieces, and on the left there was more motion at the different joints. It is tolerably certain, as the author implies, that the joints were degenerating and that earlier in life they permitted more motion. The thyroid was abnormally close to the hyoid.

CASE 14.—RETTGERER'S case is a very striking one. It was observed on both sides of a man of sixty. The body of the hyoid was very large, with widely diverging greater horns. The two sides differed considerably. On the right the bony rod measured 9.5 cm., with an average diameter of 5 mm. It consisted of two pieces, the upper measuring 2.5 cm. and the lower 7 cm. There was an enlargement at their junction which was surrounded by fibrous tissue and at which some indefinite motion was allowed. The upper piece rested against the vaginal process and was not fused with the temporal; the lower was attached to the hyoid by fibrous tissue. On the left the styloid, 1 cm. long, was fused with the temporal. (Very probably this was the tympano-hyal.) Its lower end was attached movably to the stylo-hyal, 1.5 cm. long, from which a cord ran to the cerato-hyal, 3.5 cm. long. The lower end of this was continued by a ligament of 1.5 cm. to the lesser horn, which measured 2 cm. and was movable on the hyoid. These two chains passed about 2 cm. internally to the ramus of the jaw and were connected with the fibrous tissue covering the internal pterygoid.

The following case by Turner much resembles case 4.

CASE 15.—“On the right side of a male subject, the styloid process, 31 mm. long, was from two to three times as thick as customary; and instead of ending in a point, formed an expansion, 13 mm. in antero-poste-

rior, and 9 mm. in transverse diameter. Below, and articulated with it by a movable joint, was a bar of bone, 56 mm. long, which passed downwards to articulate with the small cornu of the hyoid. This bar was thickest at its upper end, and measured 10 mm. antero-posteriorly, and 8 mm. transversely, whilst at the lower end its dimensions were only 4 by 3 mm. The small cornu was somewhat thickened, and had its usual articulation at the junction of the body with the great cornu of the hyoid, which parts of that bone had their customary appearance. When the right arrangement in this neck is compared with the normal condition in a dog, the bar of bone is seen to be the homologue of the epi-hyal bone in this and many other mammals. There was no vestige of a right stylo-hyoid ligament, the place of which had been taken by the epi-hyal."

The left side was practically normal.

CASE 16.—MR. E. T. PORTER exhibited before the Dublin Pathological Society a specimen of abnormal styloid processes which, as he observed, was of more interest from an anatomical than a pathological point of view. They were styloid processes, much longer than usual, and not so firm and osseous, but rather slender and flexible. They were attached to the temporal bone by cartilage, instead of bone, and in the same subject there was no styloid muscle or ligament. They were situated between the carotids, and so placed that it would have rendered ligature of either vessel extremely difficult.²

CASE 17.—The following very remarkable case described by KOSTANECKI is unique. It was observed on the left side of a man of sixty-four. A projecting plate of bone turned backward from where the angle of the lower jaw should have been and played against a really immense styloid, by what may be called a false joint or a bursa, but the description is inadequate. The styloid, or more accurately, the stylo-hyoid chain, consisted of two long pieces with a small, flat, rounded piece of bone of irregular shape between them, which was connected by a false joint with each of the others. The first piece was a thick, rounded rod descending from the skull and becoming broader below. The lowest piece, short and thick, was connected by a ligament (which must have been a short one) with the lesser horn. The intermediate piece was surrounded by a dense envelope of fibrous tissue seemingly continuous with the periosteum of the others. The process on the lower jaw was against the joint below the intermediate piece when the mouth was closed. It was learned that the man had had no symptoms during life.

Besides the above, which may be called dissecting-room cases or museum specimens, there are a few clinical observa-

² It may be questioned whether this case should have been admitted; for, of course, if we are to record uncommonly long styloids there will be no end to it. But it must be remembered that styloids which deserve to be called "much longer than usual" probably reach very nearly to the hyoid, like those of my second case, as was noted in the dissection and confirmed by the X-ray.

tions on the living. As long ago as 1870 Lücke reported two cases.

CASE 18.—The first was that of a woman of thirty who had long suffered from difficulty in swallowing. An examination of the fauces made both within and without, revealed on the right a long slender process which pressed the tonsil inward.

CASE 19.—His other case was that of a girl of twenty, who also had difficulty in swallowing. Again there was found on the right side a slender, bony process which pressed against the tonsil. It is stated moreover that in this second case it narrowed the posterior nares on the right.

The first and most important deduction to be made from these cases is that the usual term "ossification of the stylo-hyoid ligament" is wrong and misleading. On the contrary, they support the contention that this condition is due to a continued growth and subsequent ossification of the second branchial cartilage. This does not prevent a degenerative ossification from playing a minor part which probably manifests itself most strongly in the destruction of the joints between the different pieces occurring late in life.

The condition is a theromorphic one; that is, one in which parts of the human body show an exceptional structure which is normal in certain animals as a consequence of a common plan of development.

In at least three instances the hyoid was enlarged. In that of Serres "the body of the hyoid was very large . . . the greater horns slender and very wide-spread." In that of Poirier and Meunier "the greater horns of the hyoid were remarkable for their size . . ." In Retterer's "the body of the hyoid was very large with widely diverging greater horns." It is likely that this would have been recorded much more frequently had all the hyoids been examined.

The sex is given in 12 cases. Of these 9 occurred in men (to which might be added one in which I made the diagnosis from the skull) and only 3 in women.

As to the age: 6 were fifty years or more and 6 less than fifty. Assuming that I was right in estimating the age of

my second case at about twenty-five, none of these 6 had reached thirty-one years. It is clear that old age is not a factor.

The condition is usually bilateral. It is so in 10 of these cases, in 5 it is on the right and in 1 on the left. There is no statement concerning 3 instances.

While it may be said that those in which the ossification was found on both sides were in the main symmetrical; yet it is common to find considerable departures from symmetry in the details, such as the value of certain elements of the chain and arrangement and efficiency of certain joints.

The condition of the joints between the different pieces, including the lesser horns of the hyoid, is very uncertain. In many cases it would appear that joints once present had degenerated; but there is no single case in which the hyoid is firmly attached to the chain so that no motion is possible between them. The nearest approach to this is in Meunier's case (13) in which there is a bony connection in an old man between the thyroid and the hyoid, a change, which as mentioned above, probably occurred late in life. In short, there is usually more or less play between different parts of the chain and practically always near the hyoid, sometimes by a joint below the lesser horns and sometimes by a joint or more often a ligamentous connection above.

III.

The clinical deductions I venture to assume to be the following:

It is to be remembered that a bony rod may extend from the styloid process to the hyoid. It may be slender or thick. In the former case it is at least in early life, more or less flexible and elastic; in the latter it presents enlargements which at first, as a rule, mark the position of joints. This rod passes between the carotid arteries and may interfere with operations for tying them, and with those on the parotid gland which it probably indents on the inner side. Passing by the internal pterygoid, to which it is attached by the fibrous en-

velope of that muscle, it lies against the outer side of the tonsil which it may indent or displace. It evidently would interfere with excision of the tonsil by the tonsilotome or otherwise. Some years ago I received a letter from a laryngologist who had come across such a structure while operating. I believe that others have had the same experience but I know of no instance which has been reported. The displacement of the tonsil may be sufficient to seriously reduce the approach to the pharynx and even to encroach on the region back of the posterior nares.

It may give rise to difficulty in swallowing. In this connection it is worth noting that the two cases observed during life by Lücke were both young. One would think that the trouble would be greater after the solidification of the joints, especially if the joints above and below the lesser horns of the hyoid should be involved, but as yet there is no clinical evidence.

It is not unlikely that the play of one part of the rod on another should give rise to disagreeable subjective symptoms and even to sounds that could be heard by others, although Kostanecki's remarkable case (17) shows that this does not necessarily occur.³

A diagnosis may be made by bimanual examination and the X-ray would settle the matter.

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³ The late Professor Henry J. Bigelow told me many years ago that perhaps the most curious case he had ever seen was that of the "clicking woman," who, I believe, went for advice to the Massachusetts General Hospital, and left not only unrelieved, but without the satisfaction of a diagnosis. As well as I can remember she was troubled by a continual, plainly audible clicking, which seemed to be produced in the region of the larynx.

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ACUTE DILATATION OF THE STOMACH—GASTRO-MESENTERIC ILEUS.

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IN the study of 459 cases of hernia finished in January, 1899 (The Johns Hopkins Hospital Reports, vol. vii), I was not familiar with postoperative or primary acute dilatation of the stomach. For this reason I looked upon the only example of postoperative obstruction in this group of cases as a high intestinal partial occlusion. The patient was relieved, and recovered without a secondary operation.

In May, 1901, I operated for the first time for symptoms of intestinal obstruction following an operation under chloroform narcosis for reducible inguinal hernia. In this instance a loop of jejunum was caught in Treitz's fossa. The patient recovered. In the report of this case (ANNALS OF SURGERY, 1903, vol. xxxviii, p. 806) the possibility of an acute dilatation of the stomach is not discussed.

Later these two cases will be mentioned in the differential diagnosis between gastro-mesenteric ileus and high occlusion of the small intestine.

In March, 1904, my attention was first called to this post-operative complication in a case of appendicitis; here the clinical picture was distinct, the rapid epigastric distention associated with vomiting of large quantities of duodenal and gastric contents, and the rapid prostration differentiated the lesion from a high intestinal obstruction. The autopsy by Dr. Fisher confirmed the clinical diagnosis.

Such a distressing experience called my attention to the literature, which I should have been familiar with before. From now on I kept this postoperative complication in mind.

In September, 1904, when Dr. Sowers told me of the clinical picture of a patient who had died that day in the

surgical ward of the Johns Hopkins Hospital and on whom an autopsy was about to be performed, it was not difficult to conclude that death was due to a gastro-mesenteric ileus. The illustrations (Figs. 3 and 4) were made from my sketches taken at the autopsy. This case, operated upon by Dr. Finney, has been reported by him (Boston Medical and Surgical Journal, vol. clv, August 2, 1906, p. 107).

In July, 1906, I observed for the first time a lesion of the duodenum and the stomach which I think may be looked upon as a primary *chronic* gastro-mesenteric ileus, or chronic dilatation of the duodenum and stomach (see Fig. 6).

In March, 1907, I saw for the first time a case of primary acute gastro-mesenteric ileus. The complication had its onset during the convalescence from a very severe attack of acute articular rheumatism (see Figs. 1 and 2).

In discussing the cases which have come under my observation I feel that the subject can be presented best by first giving in detail the last observed case. Here the clinical picture was unusually distinct, and I was able at the operation and autopsy to investigate the pathologic anatomy.

CASE I, Path. No. 8025, J. D., patient of Drs. Pound and Seegar.

Primary acute gastro-mesenteric ileus, symptoms three and a half days; onset during convalescence from a severe attack of acute articular rheumatism...The symptoms began directly after the first solid meal, in a patient greatly emaciated and weakened by a long illness. The symptoms consisted of epigastric distention, gastric dilatation and peristalsis, vomiting of large quantities of gastric and duodenal contents, flatness of the lower abdomen and absolute constipation. The leucocytes were 40,000. There was no fever.

Operation: great dilatation of stomach and duodenum up to the mesentery, collapse of the small intestines; jejunostomy; death (Figs. 1 and 2).

I saw this patient on March 11th, 1907, with Drs. Pound and Seegar of Baltimore. The patient was a male, aged twenty-four. He was the only child of rather poorly developed parents and had always been delicate. About six weeks before he was taken

with an attack of high fever associated with great swelling of many joints. The condition was looked upon as acute articular rheumatism. He was critically ill. There was every evidence of some cardiac lesion. After the fever disappeared and the joint symptoms subsided the patient continued to have a very rapid pulse. His emaciation and weakness became extreme. During the beginning of the attack he was given large doses of salicylates.

For about a week the patient had been better, the pulse rate had reached normal.

The onset of the acute attack began a few hours after his first meal of solids which included raw tomatoes. I saw the patient three and a half days after the beginning of the symptoms. The clinical picture from the onset had been the same—continuous epigastric distress, with intermittent colicky pains, fullness of the upper abdomen, flatness of the lower abdomen, vomiting of large quantities of a dark brown fluid at irregular intervals. The constipation was absolute; the quantity of urine diminished; there was no fever. The pulse had become more and more rapid. The treatment had consisted of high enemata and cathartics. The stomach tube had not been used.

Examination.—The patient is extremely emaciated; although the face is pale and sallow the lips have a bright red color. The pulse varied from 130 to 140; it was very weak. While I was looking at the patient he complained of a colicky pain and vomited about six ounces of a dark brown fluid, which contained mucus and a little blood. This fluid had a sweetish odor and did not remind me of normal gastric contents, but of the contents of the duodenum. As one looked at the abdomen there was distention in the epigastrium with an almost scaphoid abdomen below. When the patient complained of a colicky pain one could see a broad peristaltic wave pass from left to right in the area of distention between the costal margin. The distended area was tympanitic, and this tympany extended on the left to the nipple line above and the posterior axillary line behind; less to the right, partially obliterating the liver dullness. On palpation one could not positively make out the stomach because the muscles were held rigid and the patient complained of some tenderness. The lower abdomen however was soft, the rectal examination negative.

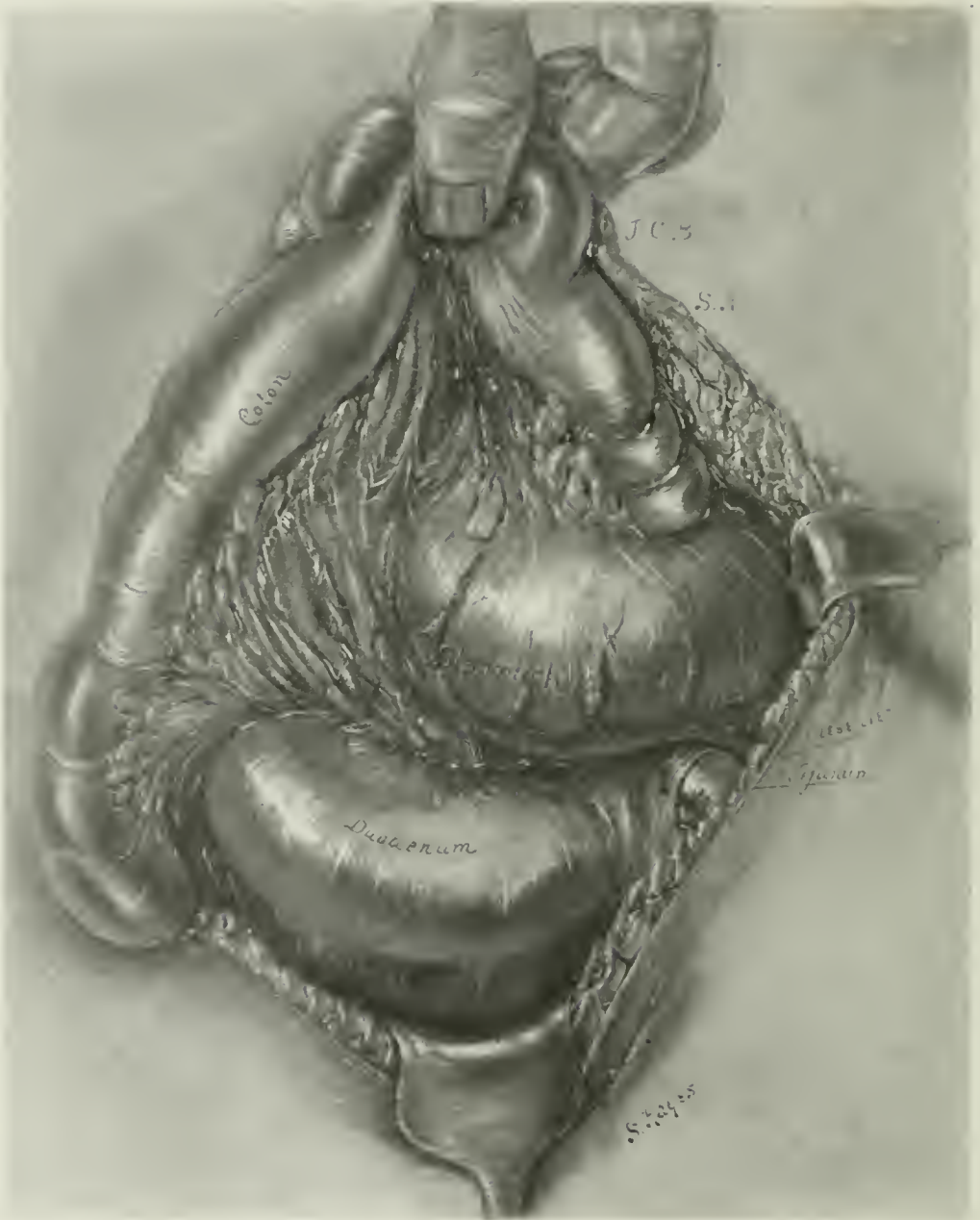
A diagnosis of gastro-mesenteric ileus was made and the possibility of a high intestinal occlusion considered.

FIG. 1



CASE I.—Acute gastric and duodenal dilatation. Appearance of stomach and duodenum at operation. Author's case.

FIG. 2.



CASE I.—Acute dilatation of the stomach and duodenum. Appearance of stomach, lower portion of duodenum, mesentery and collapsed jejunum; transverse colon lifted up. Author's case.

After the patient reached the St. Agnes Hospital the leucocytes were found to be 40,000. During his transportation he continued to vomit and the pulse had increased to 150. On passing a stomach tube at least a litre of dark brown fluid was evacuated. It required at least ten minutes before the washings came away clear. This suggested that there was a dilatation at least of the duodenum as well as the stomach. The patient was given a subcutaneous salt infusion. The distention rapidly disappeared, his pulse improved and he said he was more comfortable. After an observation of one hour the distention returned. I now thought that perhaps the condition might be due to a high intestinal occlusion for which operation was indicated, and for this reason advised exploration of the abdomen. I am now of the opinion that this was a mistake, and that treatment by the stomach tube and salt solution infusion should have been continued. This treatment is the best for gastro-mesenteric ileus, and in this instance, if there had been an intestinal occlusion lower down, an operation three and a half days after the onset upon a patient so critically ill would promise too little to justify the procedure, especially as the symptoms favored gastro-mesenteric ileus. I consider the operation at this time in this case a mistake in judgment.

Operation Findings.—When the abdomen was opened through the right rectus under cocaine infiltration an enormously distended stomach presented itself. The lesser curvature was pushed against the liver, the greater curvature below the level of the umbilicus. As the stomach was full of gas it bulged out of the wound like a balloon and I had to push it back into the abdomen to examine the duodenum. The duodenum appeared as a dilated U-shaped tube situated high under the liver; the base of the U lay a little to the right of the gall bladder notch (Fig. 1). I wish to emphasize first that there is no gastropnoxis. Although we see adhesions between the duodenum and the gall bladder in the region of a normal mesenteric attachment, these have not produced the obstruction.

The transverse colon was collapsed, and when I lifted it with the omentum out of the wound I exposed the dilated stomach and duodenum (Fig. 2). The duodenum was tense and dilated up to the position of the mesentery. On the other side the jejunum was collapsed. The stomach and duodenum appeared like a

blown-up balloon, the duodenum fixed, the stomach movable. At the position of the junction of the duodenum and jejunum over which the mesentery and its vessels pass, the stomach pressed downwards with great force. There were no adhesions at the position of obstruction, nor could I by compression force anything from duodenum to jejunum. The obstruction was situated directly behind the mesenteric vessels. As shown in Fig. 2 the duodenum, before it passes beneath the mesenteric vessels through the mesentery, curves upwards and then, as it passes through the mesentery and becomes the jejunum, curves downwards, like the letter S. All the small intestines were collapsed, and it did not appear to me that their position was unusual. In many autopsy cases it is noted that the majority of the small intestines is in the pelvis. I could not demonstrate this in my case. It is very difficult to illustrate correctly the exact picture. The operator obtains his view of the duodenum first on the upper side of the colon, then on the lower by pulling the transverse colon up and down. He sees the contrast between the dilated duodenum and the collapsed jejunum by looking first to the left of the mesentery, and then to the right. The greater portion of the dilated stomach does not come into view. The diagnosis of an obstruction at the duodeno-jejunal junction is first suggested by the continuation of the dilatation of the stomach into the duodenum—an entirely different picture from that observed when the obstruction is at the pylorus. The diagnosis is confirmed the moment one lifts the transverse colon and exposes the duodenum and jejunum. In the case under discussion it required less time to see these things and to make the diagnosis, than to describe them.

Finding that I could not compress the contents of the duodenum into the jejunum, although I could pass my index finger through the mesenteric opening, invaginating either duodenum or jejunum, I decided to do a jejunostomy, and pass a tube into the duodenum. This was done with immediate relief. I considered that this procedure was more rapid and met the indications as well as a posterior gastroenterostomy. In addition, it evacuated the duodenum as well as the stomach.

The patient survived the operation about two hours. On opening the abdomen at the autopsy the tube was found in the duodenum which was empty, but still somewhat dilated, the stomach was very much smaller, but still large and practically empty.

Perhaps the duodenum was situated higher than usual in this case, but it seems to me that the high situation could be explained by its great distention and can be excluded as a factor in the obstruction.

Here is an undoubted observation of acute dilatation of the entire duodenum and stomach with no evidence of adhesions and no gross anatomical changes at the duodeno-jejunal junction different from normal. Whether dilatation was primary in the stomach or duodenum could not be established.

CASE II, Pathol. No. 8326, S. H., previously reported by Dr. Finney (*loc. cit.*).—*Acute postoperative gastro-mesenteric ileus. Death six days after operation (pyloroplasty, Finney's method). Continuous vomiting with rapid pulse after operation. Mouth excoriated by pancreatic juice in the vomitus. Autopsy (illustrations, Figs. 3 and 4).*

The patient was a white female about thirty-five. Three years previously she had an acute attack of an abdominal lesion diagnosed acute gastritis, which had kept the patient in bed for three months. The details of this attack are not given in the history. The patient continued to suffer from epigastric distress and belching after eating. Two months before she was admitted to the medical clinic of the Johns Hopkins Hospital an operation had been performed on some pelvic organ. Since this time the patient has vomited almost daily.

From June 17 to September 7, a period of almost three months, she was under treatment in the medical clinic. The chief symptom was inability to retain food. In spite of attempts at careful feeding and rectal enemata with absolute rest in bed, the patient lost weight and strength, and the blood-count showed a progressive secondary anemia. At no time was it possible to make out a dilatation of the stomach, nor gastric peristalsis. The residuum in the stomach was never more than 75 c.c.; HCl was always absent; the total acidity was low—about 10; lactic acid was present. I emphasize this clinical picture, because it resembles my case of chronic dilatation of the stomach and duodenum.

At the operation by Dr. Finney the stomach was but moderately dilated. The duodenum was situated high under the liver, but there was no kink in the duodenum. The pylorus easily admitted the index finger. There was slight scar formation on

the anterior wall of the stomach near the pylorus. There is no note whether the duodenum was examined to the jejunal junction.

After operation the vomiting was worse. Before operation she had only vomited when given food. After operation she vomited at intervals of from three to six hours. The vomitus was green and then dark brown in color; it excoriated the mouth as if it contained pancreatic juice. Associated with this there was a very rapid pulse—128 to 140. At first there was moderate epigastric distention, but this with the vomiting ceased twenty-four hours before death. The patient had a number of stools, more than one would expect from the nutritive enemata. The stomach tube was passed on the fourth day only: the result is not noted in the history.

Dr. Sowers told me about this patient the day I came on duty at the Hospital. The clinical picture impressed me as one of postoperative gastro-mesenteric ileus. As an autopsy was about to be performed, we immediately went to the pathological laboratory and found that the abdomen had been opened, and the small intestines handled. Dr. Francis who was performing the autopsy allowed me to examine the stomach and duodenum and to make sketches.

The findings were almost identical with those described and illustrated in Case 1, except the stomach was but moderately dilated and was not pressing upon the mesentery; the duodenum was just as distended, but was not situated as high as in Case 1. This is easily explained by the fact that in the Finney pyloroplasty the duodenum is freed and pulled down in performing the suture.

In Fig. 3 the small intestines have been removed: the stomach is not dilated. The characteristic changes in the anatomy of the pylorus after a Finney pyloroplasty are beautifully shown: the dotted lines represent the suture. Just below this in the duodenum there is a kink always observed after this operation, but which has produced no obstruction. The suture had healed perfectly; it was covered with a thin fibrinous exudate and slightly adherent to the liver. The dilatation of the duodenum and its marked U-shape is well shown, and should be compared with Fig. 1. When I cut away the transverse colon and the small intestines the dilatation of the duodenum up to the mesenteric vessels, and the collapsed jejunum forming the S-curve were distinctly seen, and are shown in Fig. 4, which should be compared

FIG. 3



CASE II.—Acute dilatation of stomach and duodenum after a Finney gastroduodenostomy; drawing made from sketch by author at autopsy. Small intestine cut away.

FIG. 4.



CASE II.—Same as Fig. 3; transverse colon cut away. Note relation of mesenteric vessels to position of obstruction.

with Fig. 2. When I cut the jejunum near the mesentery it was empty and nothing escaped. When I pressed upon the duodenum there was no leakage. But when I passed my index finger through the jejunum into the duodenum a large quantity of thin, brown fluid escaped, and the duodenum collapsed. At operation, therefore, in Case 1, and at autopsy in Case 2, compression of the duodenum could not force its contents past the obstruction behind the mesenteric vessels into the jejunum. It seemed to me there was a valve-like kink due to the tension of the distended duodenum, and not to traction on the jejunum by the weight of the small intestines—an explanation quite frequently given in the literature.

CASE III, Pathol. No. 7442, Mrs. R.—*Chronic gastro-mesenteric ileus, or chronic dilatation of duodenum and stomach. Exploratory laparotomy. Death in twenty-seven days. Partial autopsy.* Illustration, Figs. 5 and 6, of findings at operation.

This patient, a white female aged forty-two, was referred to me by Dr. Carr. She was a married woman and until a year ago had been comparatively well. She dates her illness, however, to an attack of mumps from which she suffered about two years ago. During her convalescence she suffered from abdominal pain and nausea which have been present off and on since. During the last year she has had five acute attacks, the last five weeks ago. These attacks consist of pain in the left side of the abdomen with nausea and vomiting. The severe attacks last about three days and are relieved by calomel. Between the attacks the patient suffers with indigestion and belching. With the last attack, five weeks ago, there was diarrhœa.

Examination.—The patient is thin and not well nourished, restless, nervous and unusually apprehensive. Nothing is to be made out in the abdomen, except resistance in the epigastrium and a somewhat indistinct mass situated between the umbilicus and costal margin on the right side. This mass has somewhat the shape of a pigeon's egg and is about 5 by 2 cm. in diameter. It could be moved (Fig. 5) from side to side, but not from above down. It was slightly tender on pressure.

In view of the age of the patient and the palpable mass an exploratory laparotomy seemed justifiable.

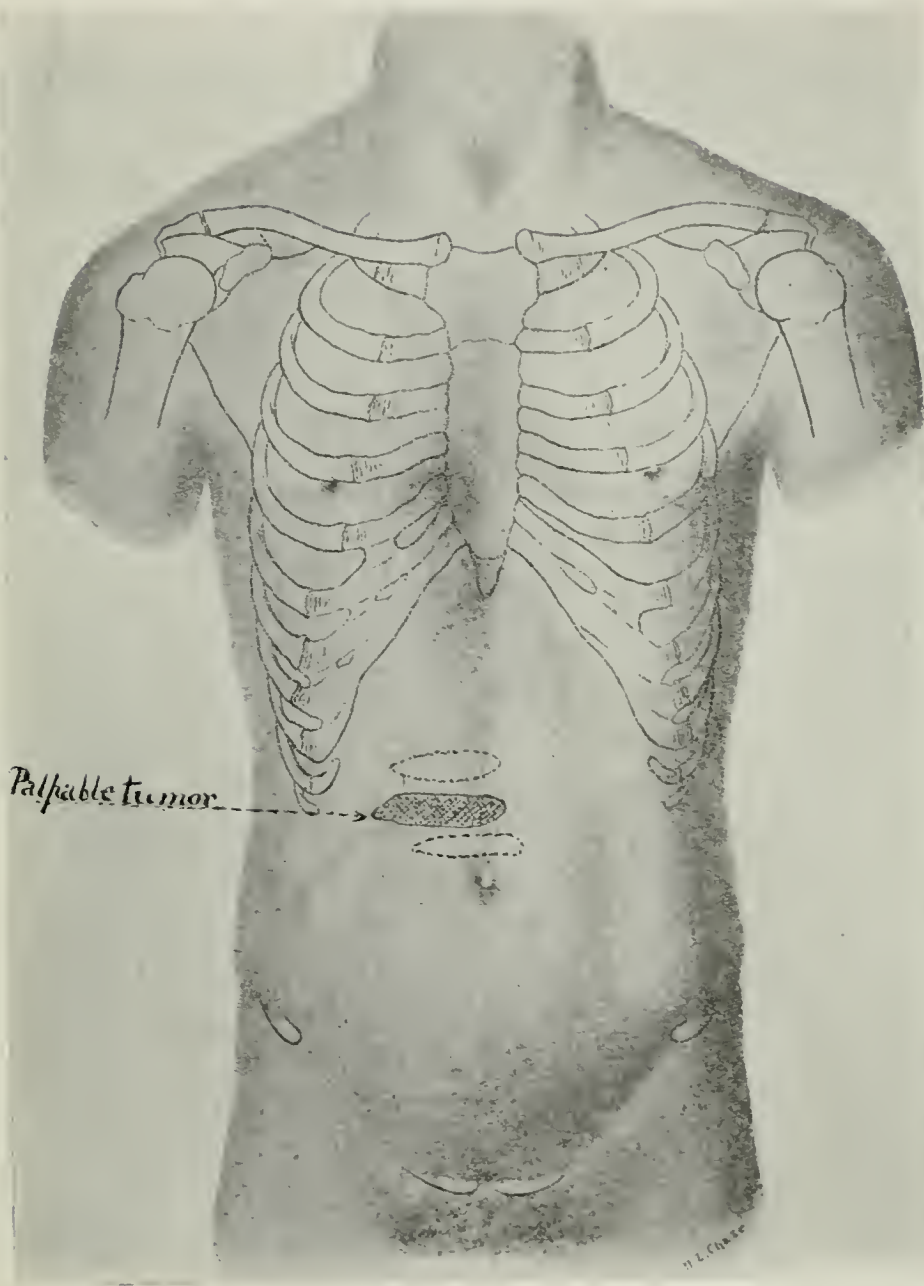
On opening the abdomen there was practically no subcutaneous fat and very little fat in the omentum. The stomach was but moderately dilated. There was no obstruction or scars

in the region of the pylorus. The condition that at once struck the operator as unusual was in the duodenum and pancreas (Fig. 6). The duodenum was a dilated, U-shaped organ extending high up under the liver and surrounded the pancreas. The duodenum and pancreas were unusually movable, the latter felt hard and indurated, the duodenum, although somewhat dilated, was soft and compressible. There were no adhesions. The third portion of the duodenum was less movable, and of about the same caliber. The entire small intestines were unusually small and ribbon-like—a condition which I have observed in a few instances when the abdomen had been opened in patients who had taken little food for a number of weeks (starvation atrophy). The enteroptosis of the stomach was but slight. The duodenum and pancreas, although quite movable from right to left, could not be pushed down, nor could I pull the duodenum out of the abdominal wound. In my only laparotomy for extreme gastropotosis I found that I could lift the duodenum and pyloric end of the stomach out of the abdominal wound as easily as a loop of small intestine. In this case the duodenum, although dilated throughout, was compressible, and there was no evidence of any accumulation of its contents. Yet the contrast between the duodenum and the jejunum as to caliber was unusual.

I have never met with, nor read of, a similar condition, and as at this time I was somewhat prejudiced against the posterior gastroenterostomy without definite indications, I closed the abdomen. In the case of gastropotosis just mentioned, the duodenum was almost as dilated and the contrast with the jejunum almost as great. As this patient had made a splendid recovery without posterior gastroenterostomy, after rest in bed and daily use of the stomach tube, I felt that the patient in Case 3, should do as well.

After operation nausea and vomiting were prominent symptoms, but there was absolutely no distention in the epigastrium, no dilatation of the stomach, no peristalsis of the stomach: the vomiting now and then contained bile; there was never any evidence of pancreatic juice; the bowels moved normally. For a few days the patient would take food, then there would be a recurrence of the inability to retain even water. Mentally, the patient was extremely depressed and apparently made up her mind to die. The intervals of slight improvement with ability to

FIG. 5.



CASE III.—Diagram of palpable abdominal tumor.

FIG. 6.



CASE III.—Chronic dilatation of stomach and duodenum. Sketch from operation findings. Author's case.

retain food for a few days encouraged the postponement of a posterior gastroenterostomy. The patient died suddenly the morning of the day selected for the secondary operation, five weeks after the primary operation. Dr. Carr was able to get an autopsy only after the body was embalmed, and the findings were the same as at the exploratory laparotomy. The embalming fluid prevented properly stained sections of the pancreas. There seemed to be, however, slight interstitial pancreatitis; the stomach and duodenum were practically normal.

These are the only three cases in which I have fairly complete operative and autopsy findings.

In all three cases the obstruction began abruptly at the junction of the duodenum and jejunum, beneath the mesenteric vessels. In Case 1 the duodenum and stomach were tremendously dilated, the duodenum fixed in a high position. In Case 2, at operation, the stomach and duodenum were moderately dilated; there was no positive evidence of pyloric obstruction; the duodenum was not examined in its third portion; at the autopsy in this case the duodenum was dilated down to the mesentery, the stomach was only moderately dilated. In Case 3 the duodenum and stomach were but moderately dilated, but the duodenum, except in its lower third, was abnormally movable. Case 1 is a typical example of primary acute dilatation. We know nothing about the condition of the stomach and duodenum before the attack. Cases 2 and 3 give a clinical history which resembles a gastric neurosis more than pyloric stenosis or ulcer. I am of the opinion that chronic dilatation of the duodenum was present before operation in both cases (2 and 3). In Case 2 the condition became acute after operation. There is no evidence that the pyloroplasty was a factor in its production, and there is every reason to believe that this pyloroplasty did not and could not relieve the original condition. In Case 3, the exploratory laparotomy had no effect whatever on the clinical picture. In this third case the stomach was washed out two and three times a day; this procedure may have prevented acute dilatation, but it had no curative effect upon the chronic condition.

Theoretically, posterior gastro-jejunostomy with a short loop may have been indicated in both cases. This procedure would have relieved gastric stasis, but might have increased the duodenal dilatation. Theoretically, also a second anastomosis between the duodenum and jejunum would have to be performed to drain both duodenum and stomach. Future experience may demonstrate that in cases of this character a simple duodeno-jejunostomy is indicated. This operation, as far as I know, has never been done, nor even suggested before. It certainly meets the indications better than gastro-enterostomy and is simpler than a combined gastro-enterostomy and duodeno-jejunostomy.

In all three cases the small intestines were collapsed, with absolute constipation in the first case, but some movement of the bowels in the other two cases. In none of these cases can it be positively said that the small intestines were in the pelvis. In the two cases which I observed at operation (1 and 3) the majority of the small intestines were not in the pelvis. Free fluid in the peritoneal cavity was absent in all, and there were no adhesions and no gross anatomical lesions to explain obstruction at the mesentery. Nor was I able to ascertain whether the dilatation of the stomach was primary or secondary.

As stated before, I am of the opinion that in Case 1 the stomach tube should have been used for a longer interval before the patient was subjected to operation; it also should have been employed by his attending physician from the onset of the disease. In Case 2 operation was indicated; the patient had been given the benefit of the best medical treatment, during which time she lost strength and flesh and became more anemic. After operation here, the stomach tube was not employed as it should have been, once or twice a day or more frequently. In Case 3 the palpable tumor was sufficient indication for exploration. In the postoperative treatment nothing was neglected. Whether this patient could have been cured by a duodeno-jejunostomy, remains to be answered by future experience in other cases.

FIG. 7.



CASE IV.—Acute postoperative dilatation of the stomach. Finney's case. Photograph from alcohol specimen.

CASE IV, Pathol. No. 7352.—*Acute postoperative gastric dilatation (following a Finney gastro-duodenostomy), associated with pregnancy. Death one month after operation (Fig. 7).*

This case I have published with the illustration in the *International Clinics* (April, 1907, page 285, Fig. 27). The patient was a white female, aged twenty; for six months she had suffered from indigestion consisting of epigastric pain and nausea. For two weeks the symptoms had been very severe, with vomiting. There had been and still was discomfort directly after taking food, and vomiting two to three hours later. On one occasion blood was in the vomitus. No improvement under rest and milk diet. On examining the abdomen nothing was made out, except slight resistance and tenderness in the epigastrium. In the gastric secretion there was no HCl, and a total acidity of 28. The patient did not improve after a month's medical treatment. Pregnancy was denied and no pelvic examination made. At the operation by Dr. Finney the stomach was found to be but moderately dilated, the pylorus was slightly constricted: there was no definite scar tissue, but a few adhesions about the pylorus. The pylorus seemed higher than normal, and it is noted that the duodenum was contracted.

A Finney gastro-duodenostomy was done. After operation the patient's condition on the whole was worse—continuous vomiting, which excoriated the mouth; slight jaundice and bile in the urine. The possibility of pregnancy was then admitted by the patient.

Autopsy.—The dilatation is confined to the stomach with a kink in the lesser curvature which, however, did not obstruct the pylorus (see Fig. 7). The pyloroplasty wound had healed: the small intestines were contracted; the adhesions between the pylorus and liver noted at the operation were still present.

The fetus in the uterus indicated a four months' pregnancy.

Evidently this is an example of acute gastric dilatation following operation, yet at autopsy there was no evidence of pyloric obstruction. The note, however, on the duodenum, both, at operation and autopsy, is not sufficiently explicit to exclude duodenal dilatation. In the specimen sent to the laboratory there is but a small piece of duodenum: this is dilated.

As the patient gave a history of six months' gastric discomfort, was under treatment one month before operation, and died one month after it, the gastric symptoms antedated the pregnancy four months. The marked nausea and vomiting were of but two weeks' duration and therefore coincident with the sixth week of pregnancy. At the operation there was sufficient pyloric stenosis to explain the gastric symptoms. My colleague, Dr. Williams, professor of obstetrics, tells me that he has never observed acute dilatation of the stomach in the vomiting of pregnancy. He recognizes two forms of vomiting in the gravid woman: the first—of neurotic origin—is usually cured by suggestion; the second—toxic—is only relieved by immediate evacuation of the uterus. The liver in this case, in gross and microscopic study, did not have the appearance of that observed in the toxic vomiting of pregnancy. For this reason we must look upon this case as an acute postoperative gastric dilatation, and in view of the large opening between the duodenum and stomach made by the anastomosis, we can exclude pyloric stenosis as a factor. Although unfortunately the autopsy record does not allow us to make positive statements with regard to the duodenum, I am inclined to the view that this case is identical in its etiology with the three already discussed.

CASE V, Pathol. No. 608. J. O.—*Postoperative acute dilatation of the stomach secondary to appendectomy, drainage, and enterostomy for perforating appendicitis with general peritonitis and intestinal obstruction. The patient died twelve and a half days after operation.*

This patient, referred to me by Dr. Murphy of Annapolis, a white male, aged twenty, was operated on in the fourth day of an attack of acute appendicitis: the appendix, situated in the pelvis, was perforated; there was pelvic peritonitis with a considerable collection of pus requiring pelvic drainage. Two and a half days later an enterostomy had to be performed for obstruction due to the pelvic peritonitis.

The patient did very well for a number of days. The upper tube drained well, but the loop seemed to be short, because the discharge consisted of material but slightly digested. As the

patient grew weak it was necessary to rather force the nourishment by mouth. On the fifth day after the second operation the patient had sudden epigastric distention, and in a few hours the pulse rose from 106 to 120: at the end of four hours he vomited 300 c.c. of fluid with immediate relief: the epigastric distention disappeared, the pulse improved, the vomiting ceased, and the tube began to drain again. In my notes made at that time I looked upon the condition as an acute gastric dilatation due perhaps to forced feeding in a patient weakened very much by his disease. On the ninth day, four days later, there was a second attack with syncope; as the vomiting had entirely relieved the distention the stomach tube was not used. After this attack the general condition of the patient became worse; we could not use the lower loop for feeding, as the obstruction was not completely relieved; the rectal enemata were not well retained; we were therefore forced to employ feeding by mouth. At five o'clock on the afternoon of the eleventh day there was no epigastric distention and no vomiting: this had been absent for forty-eight hours; the patient was taking moderate nourishing without nausea; the pulse, however, was rapid. Within a few hours he began to distend and vomit. Dr. Fisher, who was looking after the patient, attempted to pass a stomach tube, but it had such a serious effect upon the pulse that he considered it wiser to desist. The patient died in collapse a few hours later.

At the autopsy by Dr. Fisher the peritonitis had subsided. The enterostomy was about fifteen feet from the stomach: the intestines below this were adherent in the pelvis; there was no obstruction between the enterostomy and the duodenum; the stomach was enormously distended with fluid and gas. No special note was made upon the condition of the duodenum.

This case can be looked upon as one of acute postoperative gastric dilatation. There were no gross changes or adhesions in the region of the stomach to suggest pyloric stenosis. Whether the gastric dilatation was associated with a similar condition of the duodenum up to the mesentery cannot be positively stated.

CASE VI, Pr. Surg., No. 1483, J. F.—*Postoperative acute dilatation of the stomach following radical cure of left inguinal hernia under ether narcosis. Stomach tube. Recovery.*

White, male, aged fifty-eight. This patient gave no previous history suggesting any gastric trouble. He was, however, a thin,

delicate looking man, and as the left inguinal hernia was a large one, he was carefully prepared for operation. This preparation consisted of, first, a saline cathartic: then forty-eight hours' rest in bed on very light diet; no further catharsis, and effectual rectal enemata on the morning of the operation. The sac contained omentum which was reduced; the Trendelenburg position was employed for about twenty minutes.

After operation the patient very quickly had epigastric distention and discomfort; the zone of tympany indicated that the chief distention was due to the stomach; there was no vomiting; the pulse was good and the leucocytes were but 10,000 (in Case 1 the leucocytes were 40,000). This patient was given immediate relief when the stomach tube was passed, but nothing was obtained except gas; the stomach was washed out: the water came away clear. On washing out the stomach one evening Dr. Smead, in charge of the patient at the Union Protestant Hospital, introduced some castor oil. The next morning the oil was still in the stomach. During forty-eight hours the stomach tube was passed about four times. No cathartics were given except the castor oil mentioned. Sixty hours after operation the patient passed gas and fecal matter per rectum for the first time, after an enema. From now on there was very little epigastric distention or distress. The stomach tube was passed on only two occasions in the next five days.

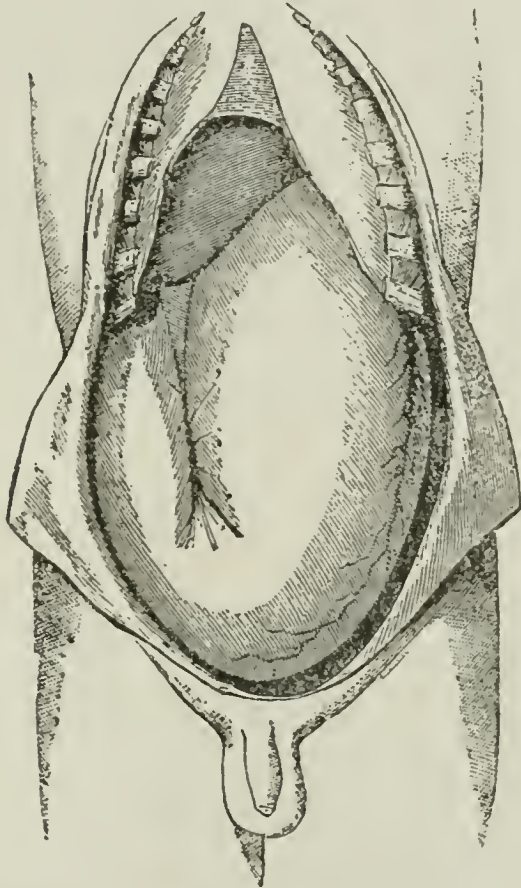
The stomach tube, after operation, is not only valuable in the treatment of postoperative gastric dilatation, but also in diagnosis. If one finds in the stomach intestinal contents, this may be looked upon as an almost positive sign of intestinal obstruction or gastro-mesenteric ileus.

Some six months later this patient was again operated on for a small right inguinal hernia associated with undescended testicle. In view of the previous complication local anæsthesia with cocaine was employed. After this operation the same symptoms appeared, slighter in degree and of shorter duration, and were again relieved by the stomach tube. On both occasions there was no accumulation of fluid in the stomach. The distention was entirely due to gas.

It seems unnecessary to lengthen this article by a long discussion of the literature. *Finney* has presented the subject

in a very systematic manner in the Boston Med. & Surg. Journal, August 2, 1906. *Halstead* of Chicago (Surgery, Gynecology and Obstetrics, vol. ii, 1906, p. 13) reports an observation of his own in which the patient died after an operation consisting in fixation of the kidney. In this case the stomach and first portion of the duodenum were dilated; the obstruction was situated in the descending limb of the

FIG. 8.



■ Acute primary dilatation of stomach associated with retroperitoneal duodenal abscess.
Copied from Fagge.

duodenum as it passed beneath the peritoneum. Other cases with obstruction at this point have been reported; the huge stomach was somewhat V-shaped, like in Finney's case (Fig. 7).

In the *International Clinics* for April, 1906, p. 285, and April, 1907, p. 284, I have given a brief résumé of the more recent literature.

WICHERN (*Mittheilungen a. d. Grenzgeb. d. Med. u. Chir.*, 1906, vol. xvi, page 791) is the first to record this complication during the acute stage of typhoid. At the autopsy in his two cases there was no dilatation of the duodenum, differing, therefore, in the anatomical findings from my Case 1. This complication has been observed during the convalescence from typhoid and in the acute stage of pneumonia and scarlet fever.

In C. HILTON FAGGE's original communication (*Guy's Hospital Reports*, series iii, vol. xviii, 1872-3, p. 1), to which all writers refer as one of the earliest contributions to the subject, there is no note on dilatation of the duodenum. The V-shaped appearance of the hugely distended stomach is shown in Fig. 8, copied from Fagge. His two cases were not post-operative, but primary. In Fagge's Case 1 the cause of the obstruction was a retroperitoneal abscess communicating with the duodenum, probably due to perforating duodenal ulcer. In his second case there was no demonstrable cause for the obstruction.

Fig. 9 is copied from THOMSON (*The Lancet*, 1901, vol. ii, p. 1113). It illustrates the V-shape of the hugely dilated stomach, which was observed at autopsy, the patient also suffering from acute lobar pneumonia and pleurisy. In this case the dilated stomach reached the pubes. There is no note on the duodenum. The autopsy record simply states that the small intestines were collapsed.

Fig. 10 is copied from a second communication by THOMSON (*The Lancet*, 1902, vol. ii, page 287), and illustrates the autopsy of a case of acute dilatation of the stomach associated with dilatation of the upper eight feet of the small intestines. The complication began just before the birth of the sixth child of the patient and continued after it. The patient died about forty-eight hours after labor. The autopsy revealed purulent peritonitis from a ruptured ovarian abscess.

Thomson uses this case as evidence against the view that in acute dilatation of the stomach and duodenum the distention begins at the mesentery, and that the lesion is a gastro-duodenal mesenteric ileus. There is no doubt that acute dilatation of the stomach has been observed to cease at the pylorus, in different portions of the duodenum, and, in a few instances, to extend below, into the jejunum. However, in the majority of cases the dilatation ends at the mesentery. I must agree with Thomson that this finding does not prove that the primary dilatation is in the duodenum, and that the mesentery is the etiological factor in the obstruction. Nevertheless, for practical purposes, it seems best to look upon this lesion as a gastro-duodenal dilatation, and if treatment by the stomach tube fails, not to neglect, at the operation, a careful exploration of the duodenum.

FIG. 9.



Acute primary dilatation of the stomach associated with pneumonia. Copied from Thomson.

FIG. 10.



Acute dilatation of the stomach associated with the dilatation of the upper eight feet of small intestine and peritonitis. Copied from Thomson.

If the dilatation ends at the pylorus gastrostomy or gastro-jejunosomy should be performed. If the dilatation involves the duodenum, I would advocate jejunostomy as employed in my first case, or duodeno-jejunosomy.

The Differential Diagnosis between Acute Gastro-duodenal Dilatation and High Obstruction of the Small Intestines. In view of the fact that in the first lesion the consensus of opinion favors treatment by the stomach tube and position of the body (knee-chest, or left lateral with elevation of the pelvis), and that in the second lesion immediate operation is indicated, it seems important to ascertain, if a differential diagnosis is possible.

High intestinal obstruction is about as rare as acute dilatation of the stomach and duodenum. The following cases which I have observed apparently demonstrate that a differential diagnosis is possible.

CASE VII.—*Postoperative intestinal obstruction, loop of jejunum in Treitz's fossa. Operation. Recovery. (Previously reported in Annals of Surgery, vol. xxxviii, 1903, p. 807).*

As an etiological factor, it is of sufficient interest to know, that this patient—a physician, aged fifty—dosed himself with cathartics for thirty-six hours before operation and then, a few hours before operation took paragoric to check the diarrhœa. The operation was a simple one for an oblique, reducible inguinal hernia. The dissection was begun under cocaine and completed under chloroform. Vomiting with intense retching began the moment the patient came out of the narcosis and continued. The vomitus was at first bile-stained and later had the odor and contents of the jejunum. There was never acute pain, but general abdominal discomfort. Forty-eight hours after operation I noted that there was moderate asymmetrical distention of the right upper abdominal quadrant with increasing obliteration of the liver dullness. There was not the epigastric distention and distress observed in acute dilatation of the stomach. With the rectal tube some gas and fecal matter came away. The leucocytes rose from 12,000 to 16,000. There was no collapse. In Case 1 of acute dilatation of the stomach the leucocytes were 40,000 and collapse was marked. In view of the increasing obliteration of

the liver dullness and the vomiting of distinctly fecal matter the abdomen was opened fifty-six hours after the first operation. There was no free fluid. On manipulating the small intestines I found some distended and then I withdrew a loop with a definite constriction. The distention extended to, and abruptly ended at, the constriction; beyond this the intestines were collapsed. The constriction seemed to be in the lower portion of the jejunum and had the appearance as if the bowel had been impacted in one of the anatomical fossæ within the peritoneal cavity.

CASE VIII, Pathol. No. 7005, T. W. S.—*Acute intestinal obstruction due to the impaction of a bolus of food. Operation two and a half days. Death.* (Figs. 11 and 12.)

The clinical history in this case suggested acute dilatation, but the physical signs were those of high intestinal obstruction. The patient was a physician, aged sixty-nine, an unusually strong, robust, fat man. The symptoms began some hours after an unusually large Christmas dinner. He was first uncomfortable all over the abdomen, then there was localized pain on the left side between the umbilicus and the tenth rib. Twelve hours after this heavy meal the pain was so intense that he became nauseated; later vomiting, which within twenty-four hours became fecal in character. I saw the patient two and a half days after the onset. The pain had been less the last twenty-four hours, the vomiting of fecal matter continued. The patient did not look very sick; the pulse was 90°. There was no epigastric distention. The liver dullness was not obliterated. There was a distinct area of dullness and fullness in the left flank which was replaced by tympany when he turned on the right side. Although the character of the vomitus resembled that of Case I of acute dilatation of the stomach and duodenum, the physical signs of the abdomen were entirely different. When I washed the stomach out it contained but half a pint of distinctly fecal matter, and the washings were quickly clean. In my note made at that time I said: "This small quantity of fluid in the stomach would almost exclude acute gastro-duodenal dilatation and favor obstruction in the small intestine."¹¹ Later I made out in the small intestine distinct peristaltic waves of the ladder pattern entirely different from the single broad peristaltic wave observed in Case I. On opening the abdomen there were some clear fluid and distended small intestines; the stomach was contracted, the colon collapsed (Fig. 11).

FIG. 11.



CASE IX.—High intestinal obstruction; dilatation of upper portion of jejunum, not associated with dilatation of duodenum and stomach. A, B¹, B², B³, B⁴, C¹, C², C³, C⁴=dilated jejunum; X=position of foreign body behind this loop. Sketch at operation. Author's case. (Scheme copied from Broedel's illustration in Kelly's Operative Gynecology.)

FIG. 12.



CASE 1X.—Position of foreign body and appearance of enterospasm. Author's case.

On pulling out the small intestines from the cecum up I encountered, first, a collapsed loop, then a movable foreign body 5.5 cm. long and 2.5 cm. in diameter (Fig. 12); just above this the intestine was constricted, and appeared as if in my manipulations the foreign body had been slightly dislodged; above the constriction the intestines were dilated. The enterolith was soft and could be easily crushed and pushed on. The constriction had the appearance of a local enterospasm and soon disappeared.

The patient died thirty-six hours after operation of anuria and symptoms of autointoxication. There were a number of stools after operation, but the patient continued to vomit some. The autopsy findings differed very little from those at operation. Apparently there had been complete small-intestinal paralysis. The point of obstruction could not be found, but as I had made an enterostomy to evacuate the distended small intestines above the constriction, I could locate its position. It was situated in the third portion of the jejunum. The latter and the duodenum were distended with fluid contents, and this distention with fluid was found eight feet below the point of obstruction. Beyond this the small intestines were somewhat contracted, demonstrating that intestinal contents had begun to move down. The stomach was not dilated. There was very little difference between the sizes of the jejunum and the duodenum on each side of the mesentery. There was no peritonitis.

CASE IX.—*Intestinal obstruction from impacted gall-stone in the jejunum. Operation in forty-eight hours. Death.*

R. J., white, female, aged eighty (patient of Dr. Hamburger). The symptoms of intestinal obstruction were distinct—initial pain and collapse, vomiting, later becoming fecal. As the patient became more toxic the pain became less. At my examination forty-eight hours after the onset, there was no epigastric distention or distress; there was very little abdominal distention; the vomiting was small in quantity and distinctly fecal. Peristaltic waves could not be made out. The leucocytes were 18,000; the patient's pulse was rapid and weak. On opening the abdomen a gall-stone was found impacted in the lower portion of the jejunum or the upper ileum. The stone was removed, the bowel evacuated, the enterotomy wound closed. The patient died a few hours later.

CASE X.—*Acute intestinal obstruction by band. Operation on the third day with enterostomy. Recovery.*

In this case acute dilatation of the stomach was not even suggested by the history, and the symptoms of intestinal obstruction were somewhat obscure. The patient was a healthy male, aged thirty-four, fat and a large eater. The symptoms began with abdominal discomfort and constipation. The initial acute pain and shock of high obstruction were absent. Later colicky pain characteristic of peristalsis were felt. Vomiting was present at rather long intervals. On the second day he vomited a pint of dark-brown colored matter. The distention of the abdomen was uniform and moderate. I was asked to see this patient on the third day by Drs. Thayer and Hammond. He was in excellent condition: the abdomen was but moderately distended; if peristalsis was taking place it could not be seen, as the patient was very fat. Obstruction indicated by the fecal vomiting was thought to be in the small intestine, as there was but little distention, although the history of constipation, colicky pain and late vomiting is that usually observed in obstruction of the large intestine. About the umbilicus there was an area of impaired resonance—a physical sign of fluid in the small intestine. The stomach tube brought away a large quantity of fluid of intestinal odor. On opening the abdomen, the upper portions of the small intestines were greatly distended; the obstruction was due a band in the pelvis below which the ileum was collapsed. As the band was divided the fluid contents passed. In view of the long duration of the obstruction the intestines were opened and evacuated, the opening sutured to the wound and closed for later drainage; this was again opened twenty-four hours after operation. The fecal fistula was sutured at the end of five weeks.

These cases demonstrate that the symptom-complex and the physical signs of high occlusion of the small intestine differ from acute gastro-duodenal dilatation. There are two symptoms in common—vomiting, and its fecal character. If my memory is correct, the odor of the vomitus which I carefully studied in Cases 1 and 6 (acute dilatation of the stomach) is less fecal in character than when the obstruction is in the small intestine. The character of the vomiting, however, is not sufficiently different to allow a differential diagnosis. In high intestinal occlusion initial pain accompanied, perhaps, by peritoneal shock which may later somewhat disappear, and

vomiting without marked distention are the symptoms which differentiate it from acute dilatation. In the latter the initial pain is absent; the patients suffer from epigastric distress; the collapse is gradual and progressive; the most characteristic feature is the abdominal distention beginning in the epigastrium and, in some cases, extending to the pubes. This distention is immediately relieved by the passage of a stomach tube.

In high intestinal obstruction, in my experience, epigastric distention is a very late symptom, and so far in my cases at operation great dilatation of stomach and duodenum has not been found (see Fig. 11).

According to the most recent monograph by *Kayser* of which I have only the review (Centralbl. f. Chir., 1907, xxxiv, p. 242), the mortality among about sixty cases of acute dilatation of the stomach has been 71 per cent.; recovery, with rare exceptions, has followed only the early and repeated use of the stomach tube. Among recent literature Beck (Centralbl. f. Chir., 1907, xxxiv, p. 577) reports the recovery of a girl of fifteen, with symptoms forty-eight hours after appendectomy for appendicular abscess in the pelvis and drainage. These symptoms consisted of epigastric pain and distention. The stomach tube removed a liter of material, although the patient had had no food; in spite of nothing by mouth there was a reaccumulation of two liters in twenty-four hours; the stomach tube was used daily for four days. This observation of Beck demonstrates that there is a second factor in acute dilatation besides gastric atony or paralysis, and that is hypersecretion. In the literature, even in the most recent monograph by Kayser just mentioned, this factor is not dwelt upon with sufficient emphasis.

The observation of *Heile* (Mittheilungen a. d. Grenzgeb. d. Med. u. Chir., 1907, v. Mikulicz Supplement, p. 707) is the best to demonstrate that hypersecretion is a definite factor. It is also of interest in that it illustrates that in chronic dilatation of the stomach with a history of hypersecretion one should be cautious not to select a pyloroplasty or Finney operation, or a Billroth (gastroduodenal end-to-end suture) after pylorec-

tomy, but perform a gastro-jejunostomy with a short loop. In two of the cases reported by me, in which acute dilatation up to the mesentery followed a Finney operation there was evidence of hypersecretion before and after operation in both cases. In my observation of chronic dilatation of stomach and duodenum there was no definite evidence of hypersecretion before, nor after operation. In Heile's case there was a history of pyloric obstruction in a woman of twenty-seven, of eighteen months' duration; vomiting of large quantities of food was the most marked clinical symptom; the contents of the stomach showed an acidity of 60, and free HCl acid; observation before operation demonstrated that the quantity of vomitus far exceeded the intake of food.

The palpable tumor proved to be, at operation, an infiltrating carcinoma in an old ulcer. After resection the duodenum was sutured to the stomach. After operation, in spite of no food by mouth, the patient began to vomit within forty-eight hours and continued to do so for sixteen days. The daily quantity averaged about three liters; it resembled gastric secretion unmixed with duodenal contents; the condition was not relieved by the stomach tube. The patient recovered after a posterior gastroenterostomy. The duodenum was not dilated; there was no mechanical obstruction at the suture; the remaining portion of the stomach which at the operation had been reduced to less than one half, was found, at the second operation, to be as large as the dilated stomach before the first.

This case of Heile, I believe, belongs to a group of acute dilatations in which further experience will demonstrate that after a sufficient trial of the stomach tube and irrigation without relief, operation is indicated: when the dilatation ends at the pylorus—posterior gastro-jejunostomy; when it is a true gastro-mesenteric ileus—gastro-jejunostomy with jejuno-duodenostomy, or the latter alone, should be preferred.

Acute dilatation of the stomach is a lesion which we must be constantly on the alert to recognize, both, as a primary and a postoperative disease. Its recognition should not be difficult. Prompt treatment with the stomach tube and irrigation, re-

peatedly performed, is the first requirement. [In some cases the tube may have to be passed through the nose.] This should be associated with change in position—knee-chest, and left lateral with elevation of pelvis. When the dilatation of the stomach persists and the accumulated fluid fails to pass, and the patient becomes weaker from loss of food, operation should be performed.

The chief etiological factor seems to be some toxic agent in a patient weakened, perhaps, by previous disease and suffering from some chronic gastric lesion. In some cases the toxic factor may be sufficiently great to produce paralysis with hypersecretion in a stomach previously dilated. This was apparently so in my first case. In the observations during and after typhoid, in pneumonia and scarlet fever, the patient is first weakened by the disease; then, later, the acute dilatation has its onset. It seems strange that acute dilatation of the stomach has only recently been observed in eclampsia (Audebert et Fournier: *Comptes Rendus de la Soc. d'Obst., de Gynec. et de Paed.*, 1907, vol. ix, p. 116). My attention was called to this article by my colleague, Dr. Williams. In the first reported case, there were two factors—the toxins of eclampsia and the chloroform used at the delivery; the condition was recognized and properly treated with the stomach tube, and although the patient was critically ill, she recovered. In the second case, there was a third factor—a general streptococcus septicæmia from a uterine infection; in spite of early recognition and treatment, the patient died within eighteen hours after the first symptom; there was huge dilatation of the stomach, and, in addition, great dilatation of the cecum, ascending and transverse colon; there is no note on the duodenum. In my Case 2 (Fig. 4) the cecum was dilated, and I found an adhesion kinking the ascending colon just above the cecum, not shown in the illustration. In this reported case, there was an adhesion kinking the transverse colon.

In regard to postoperative acute dilatation of the stomach, surgeons should give more care to the preparation of the patient before operation, especially in laparotomy cases. For at least

forty-eight hours food should be very much restricted; cathartics should not be used just before operation; when the operation is for a lesion situated some distance from the stomach considerable attention should be given to this organ in the history and examination. I have already used Heile's case as an observation of the importance of properly selecting the operation for relief of gastric dilatation with hypersecretion associated with stenosis or tumor. When this dilatation follows operations upon the gall-bladder or the ducts, or any operation in which drainage has been introduced in the region of the duodenum, the drains should be loosened or removed immediately if there are any symptoms of acute dilatation. I now remember that Dr. Halsted had such a case in which the symptoms began with persistent vomiting of large quantities of gastric material twenty-four hours after cholecystectomy and drainage. I have had one such observation, in which the symptoms were of a lighter degree. Both recovered after loosening of the drain and the stomach tube.

Orthopedic surgeons must bear in mind the possibility of acute dilatation in their cases of kyphosis. These patients should be cautioned against over-eating, especially after a plaster jacket is applied. NECK (*Zentralbl. f. Chir.*, 1907, xxxiv, p. 58) in his most recent contribution since his collective review on this subject, reports four primary cases, with three recoveries after the use of the stomach tube; in two the patients were kyphotic and gave a history of over-indulgence in food; in one patient there was a history of only an excess of food and liquid; in the fourth an overdose of *veronal* seemed to be an etiological factor. All cases had the characteristic symptoms and physical signs.

In an extensive clinical and experimental study recently brought out by BRAUN AND SEIDEL (*Mittheilungen a. d. Grenzgeb. d. Med. u. Ch.*, 1907, xvii, p. 533) and the monograph of Kayser (*loco. cit.*) there is nothing especially new. All the etiological factors are by no means established. These two most recent communications advocate the view that the dilatation is primary in the stomach; that duodenal dilatation.

if present, is secondary, and this is brought about by a kinking at the mesentery. The latter is due to pressure of the stomach on the mesenteric vessels and traction of the mesentery of the small intestine. The primary acute dilatation of the stomach is brought about by the action of some toxins on its nervous mechanism.

In the observations of my own cases and now, after a careful reading of the literature extending over a period of three years, I am not at all convinced that we have settled either the etiology, or the pathological anatomy of this affection. To me the more interesting group are those cases in which the dilatation extends to the mesentery and in which there is no evidence of a pathologic condition to explain the obstruction other than the normal anatomical factors at the mesenteric junction of the duodenum and jejunum.

I was also impressed by the fact that in two of my observations relief of tension on the mesentery and jejunum, pressure on the duodenum, and pushing up of the dilated stomach did not relieve the obstruction nor allow the duodenal contents to flow into the jejunum. In my first case the presence of stomach peristalsis three and a half days after the onset of the symptoms is evidence against complete paralysis, and I wish to emphasize again the importance of hypersecretion.

In conclusion I again call especial attention to Case 3, which is undoubtedly an example of chronic gastro-duodenal dilatation or gastro-mesenteric ileus. Further experience may demonstrate that this is the common pathological condition of many cases of gastric neuroses, which have not been relieved by posterior gastroenterostomy, and which may be relieved by duodeno-jejunostomy.

I find that I have failed to mention the very comprehensive review of Lewis A. Conner, of New York (*Amer. Jour. of the Med. Sciences*, March, 1907, vol. cxxxiii, p. 345), who reports an observation of his own and makes a critical analysis of 102 cases recorded in the literature. In this series there was no example of the complication following operations on the stomach itself. Two are recorded among my observations,—Finney's pyloroplasty, and one from the literature. Stomach peristalsis as observed in my first case, according to Conner, has been noted in only three of the 102 observations. Conner's bibliography is complete up to date.

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TUBERCULOSIS OF THE CÆCUM,

WITH A REPORT OF TWO CASES.

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FROM the pathologic view point tuberculosis of the cæcum may be divided into three forms as follows: (1) the ulcerating form; (2) the entero-peritoneal form, and (3) the hypertrophic form.

The ulcerating form represents the ordinary intestinal tuberculosis and, like all parts of the intestine, the cæcum may present ulcerations of a tuberculous nature. When arising from an intestinal tuberculosis, the ulcerations become localized more particularly in the terminal portion of the ileum, where they may remain without extending beyond the ileo-cæcal valve; but they may also invade the mucosa of the cæcum. In the large majority of cases tuberculous ulcerations are secondary and they undergo their evolution in patients presenting pulmonary lesions. They may occasionally be primary, but, under these circumstances, they are much more localized and, in one case reported by Jaboulay, the lesion was localized on the posterior aspect of the cæcum. The ulcerations appear more commonly in the closed follicles and Peyer's patches. In shape they may be either oval or circular, while their long axis is perpendicular with the axis of the intestine. Less frequently tuberculous ulcerations primarily arise in the cæcum and from there extend to the ileum, but however this may be, whether the localization is primary or secondary in the cæcum, these ulcerations never form stenoses sufficiently narrow to prevent the feces from passing. Fibrous tuberculosis giving rise to stenosis is frequently encountered in the small intestine, but is probably never met with in the large intestine, and the cæcum in particular.

Although it has been upheld that cicatricial tissue arising from tuberculosis and producing stenosis may possibly occur in

the cæcum we can hardly admit such a conclusion, because, in point of fact, the small gut is not comparable to the large intestine and what may happen in the former cannot occur in the latter. The calibre of the large intestine is notably greater than that of the small, so that cicatricial bands and annular stenoses which may, in the small intestine, arrest the progress of the feces cannot arise in the large intestine unless in the form of incomplete diaphragms incapable at any rate of being a serious obstacle to the onward passage of the feces.

The entero-peritoneal form of intestinal tuberculosis is represented by a complete involvement of the cæcum, the terminal portion of the ileum, with involvement of the mesentery and its lymphatic glands. The ulcerations of the mucosa extend in depth, burrowing through the intestinal layers and opening in the peritoneum, which structure itself is also involved in the process. Riddled with tuberculous granulations, it is covered with lymphnodes undergoing degeneration and the formation of multiple abscesses, while numerous strong adhesions are formed between the gut and the neighboring viscera. They frequently unite the cæcum to the posterior wall and the ureter and blood vessels are included in this tuberculous mass, so that, if an attempt is made to resect the neoplasm, there is considerable likelihood of injuring these organs, so that in one instance, Czerny wounded the ureter and was obliged to do a nephrectomy. The abscesses scattered throughout the large tumor formed by the intestine and the mesentery have a tendency to increase in size; they project and burrow towards the exterior and where this is going on the integuments become red and thin, so that finally the purulent pocket opens outwards by way of a more or less tortuous and fungous fistula. As has been pointed out the intestine itself communicates with the abscess from the progress of the ulcerated process so that a solution of continuity between the lumen of the gut and the skin takes place and a fecal fistula is thus created.

These fistulæ usually open either in the anterior abdominal wall, at the umbilicus, the cæcal region, or, which is more fre-

quent, in the right iliac fossa, even in those cases where the cæcal region is invaded. Occasionally they may open into the intestine (colon or small intestine), thus creating spontaneous entero-anastomoses. Then, again, the orifice of the fistulæ may be at some distance from the lesion, such as in the lumbar region. And lastly, the suppurative process may become directed towards the pelvis, project into the vagina and thus simulate a pelvic collection.

The hypertrophic form of intestinal tuberculosis may truly be called the surgical type and, for this reason, more detail will here be given. Hypertrophic tuberculosis of the cæcum is usually primary, I might say always, if one were permitted an absolute affirmation in medicine. Primary tuberculoses are at the present time thoroughly demonstrated to exist, particularly for the bones and joints and the intestine may also be primarily attacked, the cæcum in particular. There is probably not a single operator who does not recall tuberculous lesions of the cæcum undergoing their evolution independently of any pulmonary lesion, with the general condition of the patient frequently intact, or only somewhat weakened from the fact of the intestinal lesion, which does not even appear to reach the peritoneum. After a radical, or merely a palliative operation, every trace of the process disappears and these patients become well without any pulmonary manifestations occurring, just as is the case of tuberculosis of the skeleton.

Hypertrophic tuberculosis of the cæcum is primary, and it may perhaps be said that, if in a patient tuberculous lesions of the lung are encountered at the same time as those of the cæcum, the *latter being of the hypertrophic form*, the lung involvement is the result and not the cause of the process in the intestine. In a case recorded by Caussade and Charrier, the patient presented in the beginning gastro-intestinal symptoms with a tumor in the right iliac fossa, without any stethoscopic evidence, but two years later he had beside the intestinal disturbances, pulmonary lesions. Consequently, in this case the cæcum was the primary point of infection. Clinically speaking, when a pulmonary phthisis gives rise to localizations in

the intestine, the result is an ulcerating process and not hypertrophic tuberculosis.

It is a fact that hypertrophic tuberculosis is rarely in the small intestine, its points of election being the cæcum, the angles of the colon and, lastly, the rectum.

Tuberculosis of the cæcum begins in the neighborhood of the ileo-cæcal valve. It was thought formerly that the terminal portion of the ileum was involved at the same time as the cæcum or before the latter, but, at the present time, this is no longer admitted. In the large majority of cases, hypertrophic tuberculosis commences in the cæcum, remains there and has no tendency to invade the ileum, and, although formerly many cases were published where the ileum was involved, it was because that, although the hypertrophic tuberculosis in the commencement remained limited to the cæcum, it in the course of time acquired a greater malignancy, so that to the hypertrophy of the walls of the gut ulcerations of the mucosa became added, and then only, the tuberculous process involved the ileo-cæcal valve and became propagated to the terminal portion of the ileum. Consequently, it is not the hypertrophic tuberculosis which becomes generalized to the ileum, but one is in reality dealing with a secondary tuberculous ulcerative process.

In many cases the mucosa of the hypertrophied cæcum has been found healthy, without ulcerations, while the ileum in no way participated in the process, its walls having retained their normal thickness. In other instances more or less extensive ulcerations in the cæcum have been noted, but the ileum has not as yet become invaded. And lastly, in other cases the ileum participated in the process and the mucosa of both the cæcum and ileum has been found covered with numerous, and occasionally very extensive, ulcerations.

Now, although the extension of the disease does not generally tend towards the ileum, the same cannot be said in the other sense, because hypertrophic tuberculosis may invade the ascending and the transverse colon and even extend still further. In one of Dieulafoy's cases the thickening extended to the hepatic flexure, while in a case recorded by Roux, he

was obliged to remove the cæcum, ascending colon and a portion of the transverse colon. In an autopsy reported by Pilliet and Hartmann, in a case of Bezançon and Lapointe, the entire large intestine, as far as the sigmoid flexure was involved in the hypertrophic process. To sum up, it may be said that hypertrophic tuberculosis of the cæcum takes a descending course, that is to say, towards the colon.

In some instances the neoplasm only occupies a portion of the cæcum. Two such cases have been recorded by Richelot, in one the tumor being situated on the posterior aspect of the cæcum and having the dimensions of a fifty cent piece, while in the second case it occupied the ileo-cæcal angle. Cases of this kind are rather the exception and massive hypertrophy of the cæcum is the rule. The tumor presents a bossed aspect, recalling that of carcinoma; it is hard and in size may vary from a tangerine orange to two fists. Far from producing tuberculous ulcerations of the gut or a thinning of its walls, as in other varieties of intestinal tuberculous ulcerations, this particular form is characterized by a marked thickening of the various layers and the formation of a sclerotic lipomatous mass around the cæcum, which is very resisting to the feel and easily brings to one's mind the idea of a malignant neoplasm.

This sclerotic lipomatous mass is exactly similar to that surrounding tuberculous kidneys or bladders and is the result of a defensive process for the limitation of the infection. It forms an integral part of the tumor and is even with difficulty separated from it, especially in certain portions and more particularly in the neighborhood of the ileo-cæcal valve, at which point there is a complete union between the intestinal layers and the pericæcal lipomatous atmosphere. In the midst of this sclerotic lipomatous tissue will be found the hypertrophied cæcum. The hypertrophy is never the same at all parts and may even vary very greatly. All the layers of the cæcum are involved in the hypertrophic process, but most unequally and Dieulafoy has rightly said that: "all the layers are thickened, but the hypertrophy is more particularly marked in the sub-peritoneal cellulo-fibrous and in the submucous layers." For

convenience sake, and with all due correctness, it may be said that the submucous and subserous layers form more than four-fifths of the neoplasm.

As a consequence of the hypertrophy of the walls of the gut a stricture in the lumen of the cæcum may result. The calibre of this organ may be considerably diminished, the ileo-cæcal valve almost completely occluded, but in every case one is dealing with a neoplastic stenosis and not one of the cicatricial type. Occasionally one has observed an ampullar dilatation of the cæcum instead of a stricture of its lumen, which has caused Dieulafoy to say that there exists a concentric hypertrophy with stricture and an eccentric hypertrophy with dilatation of the cæcum.

Microscopically much of interest is to be found. The mucosa participates in the hypertrophy. No ulcerations may be present and this is particularly the case in the early part of the process. Later on, the submucous cheesy tubercles may open at the surface, destroying the mucosa in certain areas and thus give rise to ulcerations which, occasionally, may occupy the larger portion of the cavity of the cæcum. Beside these ulcerations verrucose or polypous projections will be found on the mucosa and opaque white points which are very distinct and represent the caseous foci developed in the dermis of the mucosa. These points may, of course, be wanting.

The submucous layer is the structure where the primary localization of hypertrophic tuberculosis takes place. The disease begins in the lymphoid organs, the follicles and Peyer's patches, because tuberculosis of the cæcum is above all a *lymphatic tuberculosis*. The thickened submucous layer microscopically shows an unequal portion of inflammatory and tuberculous elements. It is in the midst of a collection of small round embryonal cells, generally mononuclear and with a small amount of protoplasm, in other words, inflammatory cells, which, not infrequently, give rise to mistaken diagnosis of lympho-sarcoma, where are to be found the tuberculous follicles scattered here and there. The latter are in more or less

numbers, having either a tendency towards sclerosis or caseation, according to the evolution of the affection.

The muscular layer participates but little in the hypertrophy; it is infiltrated and its muscular fibres are dissociated by masses of inflammatory cells, but they are not increased in number.

The subserous layer is greatly hypertrophied and here again one meets with a very unequal mixture of tuberculous and inflammatory elements. The tuberculous follicles are generally larger than those met with in the neighborhood of the lymphatic organs. As in the submucosa, these follicles may take on a sclerous or caseous evolution according to the type of the affection, but, as in its commencement, hypertrophic tuberculosis is benign with a slow progression, a sclerous evolution is the more frequent.

To sum up one may define hypertrophic tuberculosis of the cæcum as: the result of a battle between the inflammatory and tuberculous elements and taking place in the structures of the cæcum particularly rich in lymphoid tissue.

The result of this battle is that in the commencement, and for a long time, the tuberculous lesions are few in number, and it may even happen that they completely disappear, in which case the inflammatory elements have conquered and choked the nascent tuberculosis so that microscopically nothing is seen in the tumor but inflammatory cells without any trace of tuberculous elements.

Hypertrophic tuberculosis does not merely remain localized in the walls of the intestine, because it involves the neighboring lymphnodes, particularly those of the ileo-cæcal angle. Occasionally this lymphatic tuberculosis may extend for some distance from the primary lesion and it has been known to reach the neighborhood of the diaphragm, or extend along the aorta up to the pancreas.

In the majority of cases the ileo-cæcal valve will be found hidden in a cicatricial mass, it being retracted, indurated, thickened and superficially involved in an ulcerative process with polypoid vegetations here and there. Its indurated orifice may

be considerably narrowed, while in other cases the orifice of the valve may be obstructed by the tuberculous neoplasm, this occurring in one of my cases, which may be summed up briefly as follows:

The examination of the cæcum after resection showed that in its interior there was an irregular tumor planted on the upper aspect of the ileocæcal valve, it having a cauliflower structure and its size being that of a small apple. It obstructed the lumen of the valve completely and macroscopically closely resembled a carcinoma. The terminal portion of the ileum was dilated and somewhat thickened by a submucous infiltration. For about five centimetres beyond the cæcum the colon was also thickened, although no lesion of its mucosa was observed. The peritoneum and appendix appeared healthy and there were only three small lymphatic glands in the mesentery. Microscopical examination of the cæcum with a high power showed that the process was tuberculous. The patient, a female, 87 years of age, was seen in consultation with Dr. Dalton, formerly of Cambridge, who gave me the following history. She had complained of pain in the right iliac region for about eighteen months. This was a painful sensation with periods of increase usually occurring a few hours after eating and by and by this became so marked that the patient restricted her diet. The stools were infrequent, requiring purgatives and the patient was rapidly losing flesh.

I saw the patient during an attack of colicky pain, so that we were obliged to resort to examination under an anæsthetic. The abdomen was not greatly distended and by bi-manual palpation nothing pathologic was found in either the uterus or its adnexa. However, at about the situation of McBurney's point, or a little higher, a hard, rounded tumor could be felt, which was fairly movable transversely. To the hand it felt about the size of a large orange and did not appear to be adherent either to the deeper structures, or to the abdominal wall. The other abdominal organs, as well as the thoracic viscera gave no evidence of any pathologic process. There was little or no elevation of temperature in the evening and the pulse, of good quality, was 88.

Given the patient's general condition and the history of the case, I was inclined to believe that one was dealing with a carcinoma of the cæcum and operation was advised. An incision in

the right semi-lunar line was made and exposed a greatly enlarged and indurated cæcum covered by an apparently intact peritoneum. On account of the extreme mobility of the neoplasm resection of the cæcum was undertaken, 8 centimetres of the ileum and 6 of the ascending colon being removed along with the cæcum. The ends of the large and small intestine were then closed by a through and through hemostatic suture of linen thread, this being buried by a superficial row of continuous Lembert's suture with fine chromic gut. After this, lateral anastomosis of the ileum with the ascending colon was easily accomplished. The patient made an uneventful recovery, having a natural motion two days after the operation and left the hospital on the 20th day in excellent condition. She was seen nineteen months after the operation, for the last time, when she was found to have considerably gained in weight and was in apparent good health.

As to the condition of the appendix found in tuberculosis of the cæcum it may be said that, as in the case of the ileum, it does not in the beginning participate in the process, but later on when the lesion has become extensive and ulceration has been added to the hypertrophic mass the appendix may in its turn become involved and form an integral part of the neoplasm. In certain cases it may be completely lost to view being imbedded in the sclerous pericæcal mass.

Referring now to the symptomatology it may be said that tuberculosis of the cæcum commences slowly, sometimes arising in an otherwise perfectly healthy patient, or on the contrary in one already predisposed by some local or general affection, such as gastro-enteritis, typhoid fever, dysentery, etc. It makes itself manifest in the first place by abdominal pain and intestinal disturbances. The latter consist in alternating diarrhoea and constipation, while the abdominal pain appears in the form of violent colics, localized in the region of the cæcum. The attacks of colic may be of very short duration, rarely extending over twenty-four hours, after which they subside, leaving some sensitiveness in the abdomen, which is particularly evident in the right iliac fossa.

Constipation may be the only symptom when the affection

results in a stricture of the ileo-cæcal valve, or by obstruction of the latter by the tumor, as in the case above reported. Occasionally, the disease may commence suddenly with phenomena of circumscribed peritonitis.

After a few months, or a year or two, according to the rapidity of the evolution of the process, the lesions oblige the patient to seek surgical relief. If a suppurating perityphlitis has supervened one or several fistulæ will be found in the region of the right groin. The pus may also burrow down towards the small pelvis and reach the ischio-rectal fossa and make its exit at the side of the anus.

By palpation a tumor in the right iliac fossa will usually be discovered. A hard, resisting mass, with an unequal surface, and having a cylindrical form, will be made out, although, in many reported cases, including my own, the growth was distinctly oval in shape. In size the neoplasm will vary from that of a walnut to an orange, or even more and if not adherent to the abdominal wall, the latter will remain smooth to the feel, while the growth will slide over the deep structures. When the tumor is adherent to the viscera contained in the iliac fossa its mobility will be more evident in a transversal direction. If there is only a tumefaction, simply giving the sensation of an indurated abdominal plaque, one would be more likely to suspect an aggravated form of appendicitis and here the diagnosis is frequently extremely difficult.

On percussion the neoplasm will usually present an area of dullness in its centre. If fistulous tracts are present, they should be prudently explored in order to ascertain their length and direction. The lymphnodes of the right inguinal region are sometimes enlarged and it is usually impossible to distinguish them apart from the tumor, or the mass formed by the enlarged glands of the iliac fossa which constitute an indurated mass which is lost in the depth of the lumbar region. One should carefully search for other localizations of tuberculosis, because these patients may already have slight lesions in the lungs or other viscera.

The functional symptoms are merely an exaggerated form

of those met with in the commencement of the disease; the pain becomes more persistent and the digestive disturbances more marked. If the process takes on an obstructive type with a rapid evolution the periods of constipation may be extremely prolonged and may last a week or more. The patient suffers in the right iliac fossa a few hours after eating, a symptom also very pathognomonic of carcinoma of the cæcum, as I pointed out several years ago in my paper on this affection, written in collaboration with Dr. Vander Veer.¹ One also meets with attacks of vomiting, the matter voided occasionally having a peculiar odor, although never fecaloid. This is due to the stagnation of the food in a dilated stomach, a condition not infrequently observed in patients afflicted with chronic affections of the cæcum. Indican may be present in the urine, as in all cases where fermentation is occurring in the intestine.

The general condition may remain very satisfactory for a considerable length of time, but finally loss of appetite and strength occur and the patient takes on a waxy look. There may or may not be a rise in temperature, but when this does occur it is apt to indicate a focus of tuberculosis in the lungs.

The hypertrophic type of tuberculosis of the cæcum affects the clinical aspects of a malignant neoplasm and, as I have already pointed out, it resembles closely carcinoma. The principal characters of this form are the development of a tumor in the right iliac fossa, whose increase in growth, ordinarily slow, but occasionally quite rapid, is accompanied by pain in the form of short, but very violent attacks of colic. It may also be characterized by evidences of intestinal occlusion, accompanied by vomiting, which, although of an alimentary nature may, as we have pointed out, have a peculiarly fetid odor. Complete intestinal occlusion has been met with, although very infrequently.

The ulcerating form simulates pure and simple inflammation of the cæcum and its appendix and usually no tumor is present, but a diffuse infiltration or a simple tumefaction may be made out. When the lesions extend to the appendix a small

¹ ANNALS OF SURGERY, January, 1902.

tumor may be discovered. The abdomen is distended while constipation and vomiting are not infrequent. In the more advanced phase chills and fever appear, indicating the formation of pus in the iliac fossa.

After a period of chronicity, interspersed with acute phenomena, which varies from months to years, the development of the lesions may cease by an appropriate medical treatment or else the symptoms may increase in intensity, the general nutrition becoming less and less, so that the patient dies from inanition as in any other tumor obstructing the intestine. Death may result from tuberculous peritonitis, while if the lungs become involved the patient dies from tuberculous cachexia.

Other serious complications bringing about a fatal outcome, such as perforation from ulceration of the intestines, or a fecal abscess arising in the cellular tissue of the iliac fossa are to be feared. If the affection evolves towards a cure, a very serious stenosis may result like any following an ulcerating intestinal lesion from the resulting cicatrix. A right-sided pleurisy is frequently an excellent diagnostic indication, and I would also mention an instance of hydronephrosis resulting from compression of the ureter by the cæcal neoplasm.

In making a differential diagnosis one of three conditions may be present, namely, (1) there is a tumor; (2) there is no tumor, but a diffuse infiltration of the right iliac fossa is detected; (3) one or several fistulæ are present in the right iliac fossa.

If the tumor is due to an accumulation of feces the galvanic current and purgation will settle the question, but, if after these means, the tumor is still felt, carcinoma of the cæcum is what usually first comes to one's mind. In both tuberculosis and carcinoma of the cæcum, especially when the former lesion is somewhat advanced, the patients present a waxy look, there is loss of flesh, while the shape of the growth, being oftentimes cylindrical and elongated in a vertical direction, adds greatly to the obscurity of the diagnosis, but what is still more perplexing is the prolonged constipation, an indication of chronic intestinal obstruction, involvement of the lymphatics

in the right groin and absence of a rise in temperature, and frequently, when the growth is examined after removal there is difficulty in coming to a correct differential diagnosis between tuberculosis and carcinoma.

As differential signs it may be mentioned that the hypertrophy is far more rapid in a case of carcinoma, likewise the secondary involvement of the mesenteric glands, while in tuberculosis the surface of the neoplasm is less bossed. Of course, these differences are in reality of very slight importance. At a more advanced phase the tumor softens, the skin becomes red and thin and adheres to the underlying structures. When the period of suppuration is reached, when by one or several fistulæ pus is given exit, the bacteriological examination of the latter, with animal inoculation, allows one to come to a correct diagnosis, but which at this advanced stage of the process is of little use.

To sum up it may be said that the long duration of the disease, the greater frequency of spontaneous or provoked pain, the relatively young age of the patients, the presence of Koch's bacilli in the stools, will greatly aid in making the diagnosis of tuberculosis of the cæcum. On the other hand, intestinal lymphadenoma, chronic adenitis of the iliac glands, movable kidney and actinomycosis are more easy of differentiation. In the female, the diagnosis is rendered difficult between appendicitis or suppurating lesions of the adnexa, but from this short consideration of the symptomatology, is to be particularly pointed out the great difficulty of differential diagnosis between carcinoma and tuberculosis of the cæcum, and secondly, the occasional impossibility to precisely determine whether one is dealing with a tuberculosis of the cæcum involving the appendix or a simple chronic relapsing appendicitis.

When the tuberculous process is distinctly limited to a portion of the cæcum, a partial resection of the organ may be undertaken, upon the condition that the intestinal calibre will not suffer from removal of a portion of the organ. If the resection, to be of any curative value, must be extensive, so that a stricture of the gut might be the consequence, complete

removal of the ileo-cæcal segment should be undertaken. When the process has involved the precæcal glands, they should be removed, or if their extirpation is rendered impossible on account of extensive adhesions with the intestinal wall, they should be incised and curetted.

A tuberculosis of the ileo-cæcal region without tumor formation and giving rise to fistulæ requires the same treatment as tuberculosis with a neoplastic formation, viz., bilateral exclusion of the diseased segment. If a general peritonitis from perforation is present, laparotomy and search for the perforation may be attempted, but this is usually a very difficult undertaking.

As far as the results of exclusion of the intestine are concerned, it may be said that they are usually quite satisfactory. This interference has been resorted to in cases of cæcal tuberculosis without fistulæ. In Ulmann's case, after bilateral exclusion with an iliac anus from the colon, there was a considerable decrease in size of the growth, while in Frank's case, in which bilateral exclusion with suture of both the small and large gut to the skin, the tumor had entirely disappeared seven years after the operation. There was only a slight prolapsus of the mucosa of the colon with a trifling amount of mucous discharge, the opening of the ileum having become almost closed. In a case reported by Ewald and seen three years later, the opening into the small gut had entirely closed, while that of the colon presented a prolapse of the mucous membrane to a slight degree and only gave issue to a serous fluid requiring a new dressing once a fortnight. In other instances intestinal exclusion has, later on, allowed one to resect the diseased structures, which, at the time of the first interference, was considered impossible.

When fistulæ are present the ultimate results of exclusion have also been satisfactory. In Wiesinger's case, the result was a fistula which excreted a very small quantity of pus, while the neoplastic mass had decreased in size and there was a great improvement in the general condition of the patient. Albert's patient was seen three months after the operation, at which

time the pre-existing fistula was found to have closed; the growth was much smaller, and, since the operation the patient had increased ten pounds. A young boy operated on by Gnesia made weight rapidly after the operation, while the tumor diminished in size and became movable. In Friedländer's case the patient increased 14 lbs. in six weeks, while Ricard's patient increased 36 lbs. in three months after the operation, the growth was diminishing and the fistula only gave issue to a small amount of serous fluid. These few instances are sufficient to show the benefit which may be derived by exclusion of the ileo-cæcal segment, while the operative mortality is small, since, out of 30 cases, there were only two deaths directly due to the interference. However, it may be said that resection of the cæcum is decidedly indicated in tuberculosis of the cæcum when the latter represents the hypertrophic type and as soon as a diagnosis is made surgical interference is at once demanded. Resection is absolutely indicated when there is a tumor without abscess formation or fistula and, under these circumstances, it is a radical operation, because it removes the focus of tuberculosis from the body. If resection is found difficult or dangerous on account of extensive adhesions intestinal exclusion is then to be preferred.

Resection of the ileo-cæcal segment was easily carried out in my second case, the patient being a woman 27 years of age and married for five years, who was referred to me with a diagnosis of movable right kidney. She had had one child two years previously, the labor having been perfectly normal. For the past eight months the patient had suffered from dyspeptic phenomena and frequent attacks of colicky pain. There was alternating constipation and diarrhœa. For the past two months there was a dull and constant pain in the right iliac fossa. Three weeks before coming under my observation the patient developed what appeared to be an inflammatory attack in the region of the cæcum accompanied by a rise in temperature, tumefaction and constipation. The attending physician at this time diagnosed the case as one of appendicitis, but, as she rapidly recovered from the attack, and as afterwards he could distinctly make out a fairly movable

tumor about the size of the kidney in the iliac fossa, he revised his diagnosis and considered it to be a movable kidney, which had become adherent in that region.

The patient was pale and thin with the abdomen slightly distended. The constipation was still persistent, requiring an enema daily and from time to time she suffered from slight colic in the lower abdomen. A tumor the size of a mandarin orange could be felt distinctly in the right iliac fossa; it was movable, particularly transversely and slightly tender on pressure. Percussion did not reveal any dullness over its surface. A careful examination of the thoracic and abdominal viscera proved negative. The urine was normal.

Given the history of the case I was rather in favor of a diagnosis of tuberculosis of the cæcum, because, although the patient was quite thin, she did not present that characteristic aspect of cachexia, so often present in malignant disease of the gut. An operation was, therefore, advised.

An incision in the semi-lunar line exposed the peritoneal cavity and a few soft adhesions uniting the cæcum to the parietal peritoneum. These were broken down with ease and the cæcum was found fairly movable, so that it could be drawn out of the abdominal wound. It was greatly enlarged, the peritoneal surface somewhat injected, and by palpation its walls were found greatly thickened and at one point near the ileo-cæcal valve a tumor could be detected. Resection of the cæcum with three centimetres of the ileum and three of the colon was quickly accomplished and end to end anastomosis with linen thread was easily done. A small cigarette drain was inserted and abdominal walls closed by three layers of sutures. Recovery was uneventful, the patient having a spontaneous motion on the third day after the operation and she was able to return to her home in seventeen days. The drain was removed on the second day and the small opening left in the abdominal wall after its removal closed in a few days.

Examination of the cæcum after removal showed that all its walls were thickened and that in the region of the ileo-cæcal valve this thickening had attained the thickness of seven centimetres and which during the operation on palpation of the organ had given the impression of a neoplasm. A careful examination of the abdominal cavity did not reveal any enlarged lymphnodes

in the mesentery or elsewhere. Microscopical examination of the cæcum showed numerous giant cells in its walls and points of caseation, so that the anatomical diagnosis was tuberculosis of the cæcum.

If a patient should present a limited focus of tuberculosis in one lung I believe that this is not the contra-indication for radical interference on the cæcal lesion, because the latter is a serious hindrance to forced feeding and when the process is removed, there will probably be a return to the normal in the digestive functions, which can only have as a result a happy influence on the general condition, thus indirectly improving the lung lesion. Acute postoperative pulmonary lesions are infrequent, but, if an extensive pulmonary infiltration is present, accompanied by an evening rise in temperature, night sweats and a rapid loss of flesh, any operation on the intestine is contraindicated. This also applies when frequent and tenacious diarrhœa is present (indicating a diffusion of the lesions in the intestinal mucosa, while a marked albuminuria, indicating a tuberculous nephritis is also a contra-indication.

STRANGULATION RESULTING FROM DISTENTION OF HOLLOW VISCERA.

ITS BEARING UPON APPENDICITIS, STRANGULATED HERNIA AND
GALL-BLADDER DISEASE.

BY CORNELIUS VAN ZWALENBURG, M.D.,
OF RIVERSIDE, CAL.

SEVERAL times during the past four years I have made the assertion that distention of the appendix back of an obstruction in any part of its lumen would interfere with its circulation even to the point of arresting it entirely.

The following experiments upon dogs were undertaken to demonstrate this fact.

The placing of an electric light bulb in the lumen of the appendix or the intestine made it possible to directly observe the circulation under the microscope and opened up a wonderfully interesting and inviting field for study.

After proper etherization a loop of intestine was withdrawn through an abdominal incision, a canula tied into one end of it and a small electric lamp into the other. The whole was then brought under the microscope and the circulation in the wall of the gut studied under different pressures by water introduced through the canula. The degree of pressure was noted on a mercury manometer, placed in circuit with the pressure bulb. The same experiment was done on the appendix and the same results obtained.

The following are the principal observations as they relate to this study.

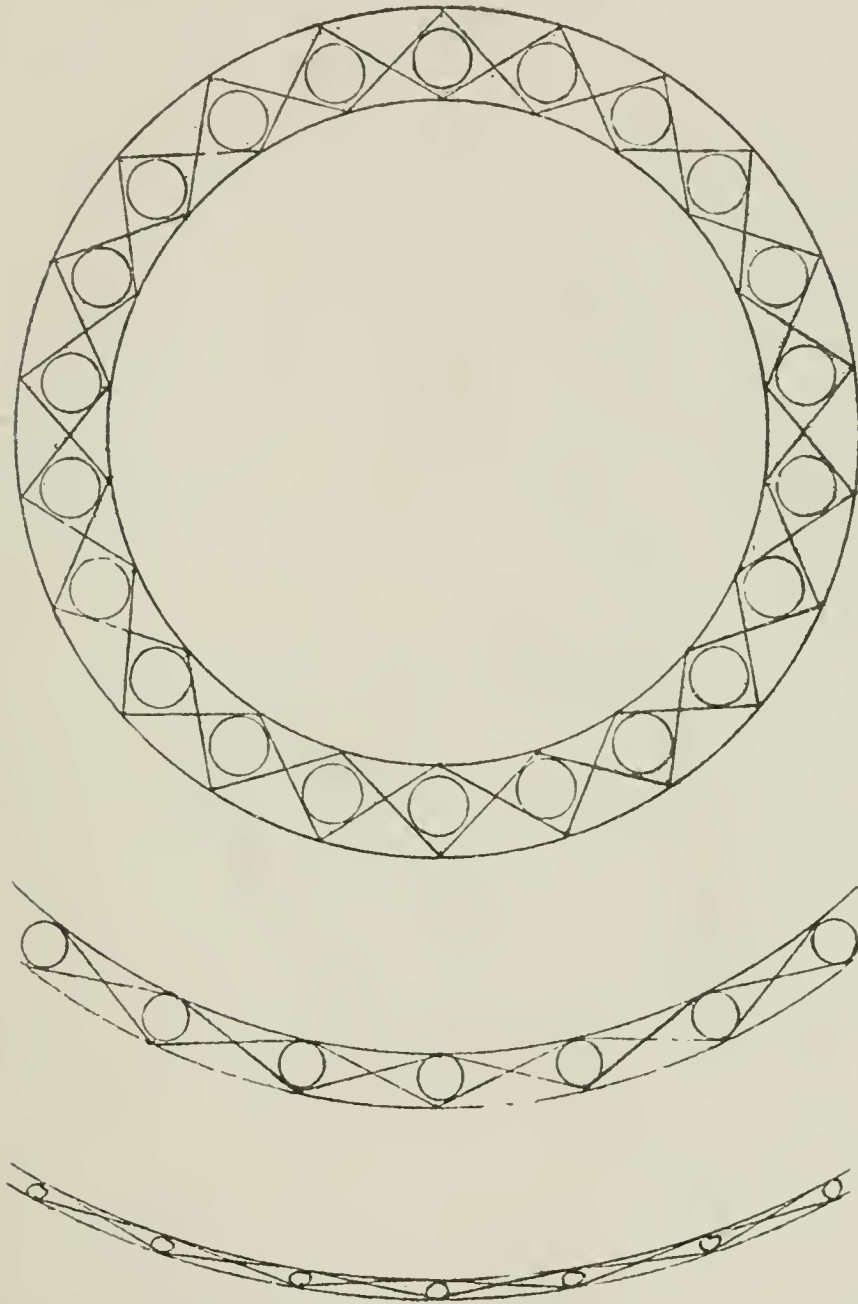
At 30 millimeters mercury pressure we found that some capillary streams were arrested.

At 60 mm. many small veins had their currents arrested, and in most of them the stream was so slow that individual corpuscles could be seen.

At 90 mm. a most interesting study presented itself. All blood streams were moving slowly and many were not moving at all. One was impressed with the difficulties encountered by the circulation in its attempt to find some point of least resistance through which the stream might insinuate

itself. Currents would at one time go in one direction and the next moment in the opposite. At the point of branching of vessels, streams were seen going in all sorts of directions.

FIG. 1.



Schematic representation of constriction of the blood-vessels in the walls of a distended intestine or appendix. (a) Normal. (b) Moderately distended. (c) Fully distended. The tense tissues in the thinning wall blot out the space for blood-vessels.

At 130 mm. all circulation had ceased—the corpuscles standing still in the blood vessels. Many vessels, however, still carried the impulse of the heart beat—the corpuscles moving to and fro, but retaining their relative

positions in the field. This pulsation was seen in some of the largest and the most superficial arteries after the pressure was carried up to 250 mm. (Fig. 1).

Some ecchymotic hæmorrhages were noted as early as 50 mm.

Gut kept at 80 to 90 mm. pressure for an hour was enormously "congested;" that is, the apparent number of veins seen on the serous surface was greatly increased and their caliber was also greatly increased.

Evidently there was great damming back against the aggressive high pressure in the arteries and, in its effort to find exit into the open veins beyond, the stream had been forced into many unfrequented paths.

Pulsation in the veins was noted frequently at the comparatively lower pressures and constantly at high pressures, illustrating the fact that capillary and venous pressures are relative—being the result of the arterial impulse as resisted by the obstruction to the venous return. The more firmly the column of blood is held the more directly and positively the impulse is carried.

That effusion accompanies such obstruction and congestion is so obvious from daily clinical observation that I shall not stop to discuss it here. Enough to say that drops of fluid were observed standing upon the surface of the gut like beads of perspiration. When we remember how quickly exposed peritoneal surfaces become dry and note that the exposure in this case was open to the dry air of Southern California the evidence of effusion becomes still more conclusive.

The demonstration seems complete that distention of gut (or of other hollow viscera) interferes with the circulation in its walls, and allows infiltration and effusion to take place into its walls and lumen and any other open space which may come within its influence.

The return circulation is retarded at comparatively slight pressures. Effusion follows, as in all obstructions to venous flow. As the average venous pressures in the intestines under ordinary circumstances probably varies from 4 to 10 mm. mercury, any pressure beyond that will offer some resistance to the return current. Tiegerstedt (Text-book on Physiology) gives pressures in a number of veins corroborating these

figures. This effusion into the tissues of the walls and into the lumen of the gut increases the distention. When the distention reaches the point where it produces a pressure in the intestine equal to that in the arteries, circulation is entirely arrested.

This mechanical interference with the circulation explains a number of surgical conditions.

In the early pathology of acute appendicitis it is responsible for most of the initial changes.

In connection with the roll of the ball valve in the etiology of appendicitis, I have discussed it in *So. Cal. Practitioner*, Sept., 1903, *Jour. Am. Med. Association*, March 26, 1904, and in the *ANNALS OF SURGERY*, March, 1905.

Acute appendicitis always finds a constricted or kinked appendix. Fecal matter, whether in the form of a concretion or not, lodges behind this constriction, forming a ball valve. Secretion behind the obstruction soon produces some distention, and pressure upon the circulation. This means effusion and more pressure and the vicious circle is established. Effusion and pressure mean infection as soon as resistance is sufficiently lowered by interference with the blood supply, and the minute traumatism and ecchymotic hemorrhages have made the entrance of germs sufficiently easy.

If the plug is fortunately driven out early through the constriction by the rising pressure the ensuing inflammation may be very slight. But if it remains the lumen of the appendix beyond the constriction becomes a veritable abscess cavity and pressure continuing to rise, necrosis or gangrene of the wall is certain to follow.

In strangulated hernia it is a very important consideration. The first step in the process is just enough obstruction at the ring to prevent the easy return of the hernial mass which has been crowded into the sac with perhaps more than its accustomed abdominal pressure. This obstruction is sufficient to retard the venous circulation. This results in effusion into the sac and into the incarcerated gut or any other organ which may be present.

This effusion increases the pressure in the sac and con-

tents, and continues until the height of the arterial pressure is reached when obviously no more fluid can be pumped into it and strangulation is complete.

Any gut present in the sac will suffer the greatest injury on account of the pathogenic germs, always present, attacking the tissues as soon as the resistance is sufficiently lowered by the poor blood supply to allow infection to take place.

In the gall-bladder it often determines the pathological condition. From this cause, in a distended gall-bladder, with an obstructed cystic duct *in the presence of germs* to produce the infection, empyema or gangrene will result. The firmness of the gall-bladder wall offers much greater protection to its circulation than does the intestine, or the appendix, nor is *complete* obstruction so common—the concretion does not commonly form in the very mouth of the duct as it does in the appendix and consequently does not make such a perfect ball valve.

In common duct obstruction infection is much less likely to take place because of the ability of the liver to take up fluids from the bile ducts and thus to keep down the pressure.

The question has often presented itself to me whether this same circulatory interference were not an important factor in gastritis and in ulcer of the stomach. It is conceivable that a heavily loaded stomach might have sufficient interference with its two exits, the œsophagus and the pylorus—to allow sufficient distention to take place to materially interfere with the circulation in the walls of the stomach, particularly the mucosa.

Minute traumatism and ecchymotic hemorrhages which are early features of this distention should receive due consideration in this connection.

In all abscesses this effusion and pressure upon blood vessels is very marked. The location of the most vulnerable blood vessels in the abscess wall being the first to succumb, determines the direction in which the pus will burrow.

Thus is explained the greater likelihood of an abdominal abscess rupturing into the bowel than anywhere else.

If a considerable surface of gut goes to make up a part

of the wall of an abscess the blood vessels in that wall will have only the thin membrane like intestinal wall to protect them from pressure. There is no possibility of their being backed up behind by exudate as that is a mucous surface.

As the abscess wall is put upon the stretch the effect upon the intestinal blood vessels is the same that it is when the pressure is from within the gut. By stretching, all interstices in the wall are blotted out and circulation is out of the question. The effect is the same as the steady pull upon the broad ligament when operating in the pelvis. As long as it is kept taut there is no bleeding, but when this tension is relaxed the blood vessels reopen and hemorrhage appears.

The vessels in the abdominal wall, for instance, have thick cushions of tissue to resist this stretching and consequent obliteration, with many blood vessels to reinforce those in the abscess wall.

With the help of the ubiquitous omentum the peritoneal exudate which makes so large a proportion of the wall of abdominal abscesses can go on indefinitely backing up with more exudate to take the place of the gradual necrosis going on "at the front."

Many other conditions which are affected by this circulatory disturbance from distention might be discussed. This is not an attempt at making this an exhaustive catalogue. I will only suggest for consideration the following:

Intestinal distention in typhoid fever with its greater danger of perforating ulcers and hemorrhage. Its importance in all forms of ileus only casually suggested by Kocher,¹ but really one of the greatest factors in the multiform pathology of that condition. Intra-cranial pressures, so beautifully demonstrated by Cushing.² Overdistentions in the urinary tracts, bladder, ureters and kidneys. Effusions into joints, with or without pathogenic germs being present. Fluids in tumors. And even in excessive uterine distention in pregnancy

¹ Ueber Ileus, Mitth. aus der Grenzgebieten der Medizin und Chur., vol. iv, 1899.

² Am. Jour. Med. Sci., September, 1902.

this mechanical burden upon the circulation should be given due consideration.

In the past few years much work has been done upon absolute pressures in the blood vessels, but outside of these there is still a wide field for investigation. The hydraulics of the body are worthy of much greater prominence than have been given them.

I wish to express my obligations to Dr. Geo. E. Tucker of Riverside, Cal., and to Dr. Haven Emerson, of New York City, for their valuable assistance and helpful suggestions.

ABNORMAL ILEO-APPENDICULAR FOLD AS A CAUSE OF PARTIAL OCCLUSION OF THE BOWEL.

BY C. HAMILTON WHITEFORD, M.R.C.S., L.R.C.P.,

OF PLYMOUTH, ENG.

A well-preserved, active man aged fifty-two, was sent to me by Dr. R. H. Clay. For the last twenty years he had suffered from discomfort in the abdomen. For the last four years, the discomfort had increased into intermittent colic.

When first seen in January, 1906, the colic, although of daily occurrence, was not of sufficient severity to make his life a burden. Operation was therefore not advised.

When seen again in November, 1906, the colic, although somewhat less frequent, had become much more severe. The attacks of pain, most intense in the region of the umbilicus, now lasted several hours, and were often relieved by muscular exercise or pressure on the abdomen.

In the last nine months the patient had lost in weight ten pounds. He has been living chiefly on milk. Constipation is habitual. He is never sick. Except for the colic, he is in good health. He has never had jaundice or any abdominal illness.

The abdomen was slightly distended and resonant, especially below the umbilicus. Gurgling in the right iliac fossa can always be elicited on palpation.

No peristalsis visible. No history of any abdominal tumor during the attacks of colic. Nil abnormal felt.

Per Rectum: Nothing abnormal to be felt.

Urine: Acid. Nil abnormal.

The patient feels that he cannot go on in his present condition of repeated severe pain.

Diagnosis: Partial obstruction of small intestine.

Operation: On 4th November, 1906, the abdomen was opened through the lower right rectus. The appendix was normal. The small intestine was empty (the result of purgatives and enemata) with one loop tied down to the right side of the pelvis. The bowel affected was the lower ileum, which for three

inches from the ileocæcal junction upwards was anchored to the right pelvic brim by a fold of peritoneum, which resembled a second mesentery and contained well-marked blood vessels. This fold was attached at one end to the convex surface of the ileum, *i.e.*, exactly opposite to the attachment of the mesentery proper, for three inches. The other end of the fold was attached for two inches to the pelvic brim. The width of the fold from ileum to pelvic brim was one inch. Towards the right the fold was continuous with the meso-appendix and peritoneum of the iliac fossa. Towards the left the fold ended in a free edge.

The rest of the small intestine was absolutely normal, as were the other abdominal contents. There were no adhesions. The free border (*i.e.*, the left border) of the fold was divided for one and a half inches between catgut ligatures.

After History: Seen on 21st February, 1907, the colic has disappeared, but, as might be expected, he is still at times troubled with "wind."

Comments.—The fold of peritoneum angled the ileum in such a manner that, with moderate distension of the ileum, a kink would be formed sufficient to cause partial, or even complete occlusion of the lumen of the bowel. Why the symptoms commenced in middle life is not obvious.

The fold is an exaggerated form of the normal ileo-appendicular fold described by Moynihan on p. 88 of his book on "Retro-peritoneal Hernia." The following details are extracted from Moynihan's description:

"The fold extends from the lower border of the ileum—that directly opposite the line of the mesenteric attachment to the anterior surface of the meso-appendix. It is quadrilateral in outline. The upper border is attached to the ileum for an extent which is extremely variable. An average length would be between $1\frac{1}{2}$ to $2\frac{1}{2}$ inches."

"Its left or inner border is concave to the left and free. This edge contains the recurrent or ileo-appendicular artery, given off almost immediately below the level of the ileum from the main appendicular artery."

"The arteries are everywhere accompanied by veins."

"Between the two layers of peritoneum in the fold are also seen some muscular fibres."

"Luschka considered that this fold acted as a regulator between the ileum and cæcum, keeping a proper and advantageous relative position

for these viscera. By means of this fold the assumption by the ileum of any extraordinary and vicious position is prevented."

The fold in the above case differed from a normal fold in (1) being attached to the pelvic brim, (2) its width, measured between its attachments to the appendix and ileum, being much less than usual.

A NEW LIVER SUTURE.*

BY VAN BUREN KNOTT, M.D.,

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IN this brief paper I desire to present a form of liver suture, simple, easy of application and efficient as a means of securing approximation of the tissues as well as hemostasis. As it is the intention at this time to present merely a preliminary report which I hope to supplement later by an article dealing more exhaustively with the subject of liver surgery no general discussion of the subject will be attempted.

The surgery of the liver, with the exception of the gall bladder and ducts, has not advanced during the past decade as rapidly as has abdominal surgery in general and standing prominently in the foreground as chief among the reasons preventing such advance has been the fear of hemorrhage.

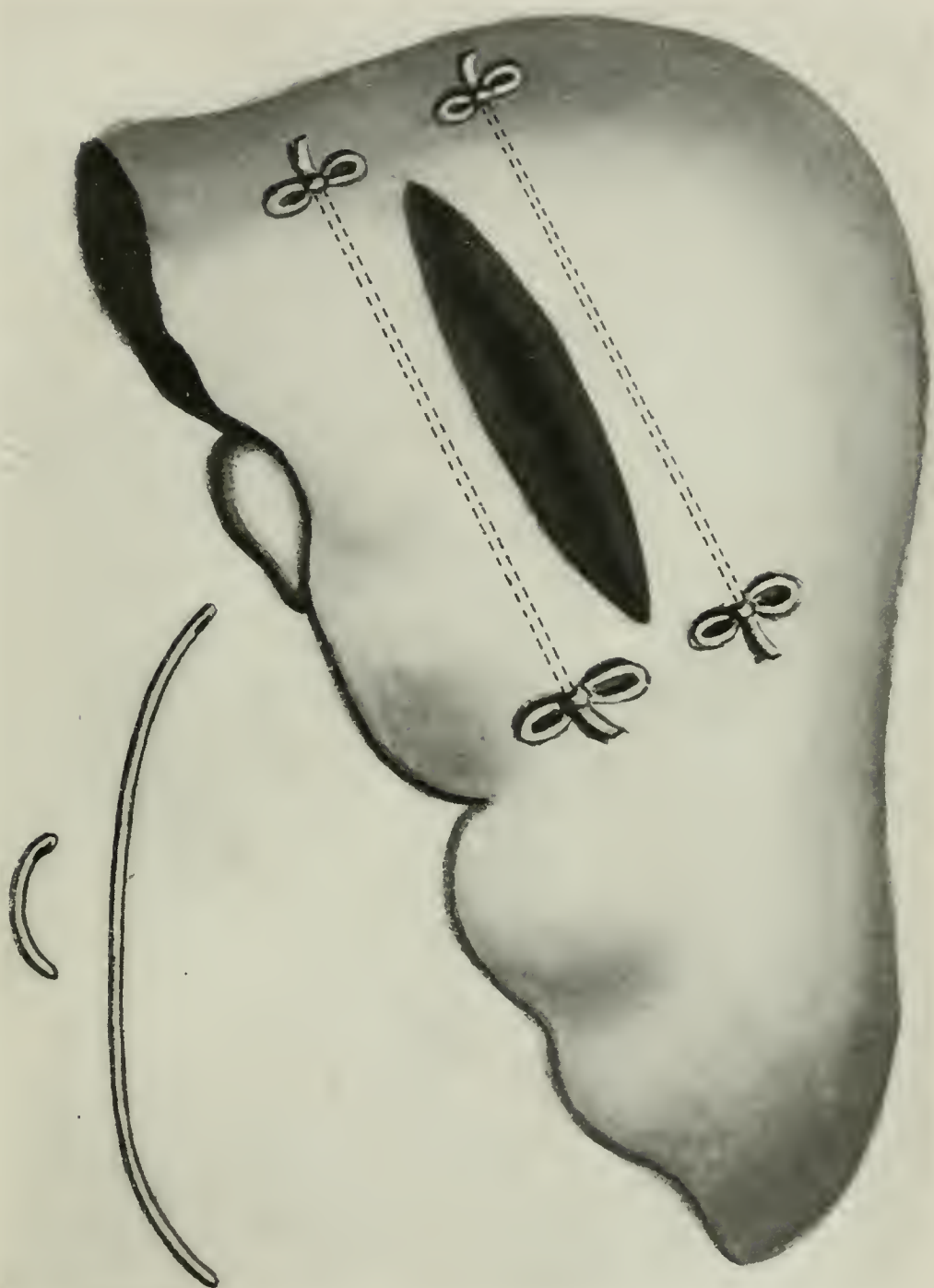
During the last few years many investigators have attempted to solve the problem and much time and ingenuity have been expended in the efforts to secure a suture which would effectually control hemorrhage and produce coaptation of the liver wound. Many of the methods reported have been most ingenious, but most of them have presented one or both of the following drawbacks. First, more or less difficulty of execution and the necessity for limiting the suture to a comparatively small area of liver tissue; second, the necessity for leaving behind in the peritoneal cavity some non-absorbable or slowly absorbable material forming part of the scheme of the suture.

Without further discussion of the methods hitherto published I shall describe a suture which experimentally has proven very satisfactory in my hands.

This suture will permit the coaptation of a wound of the liver substance at the same time controlling the hemorrhage

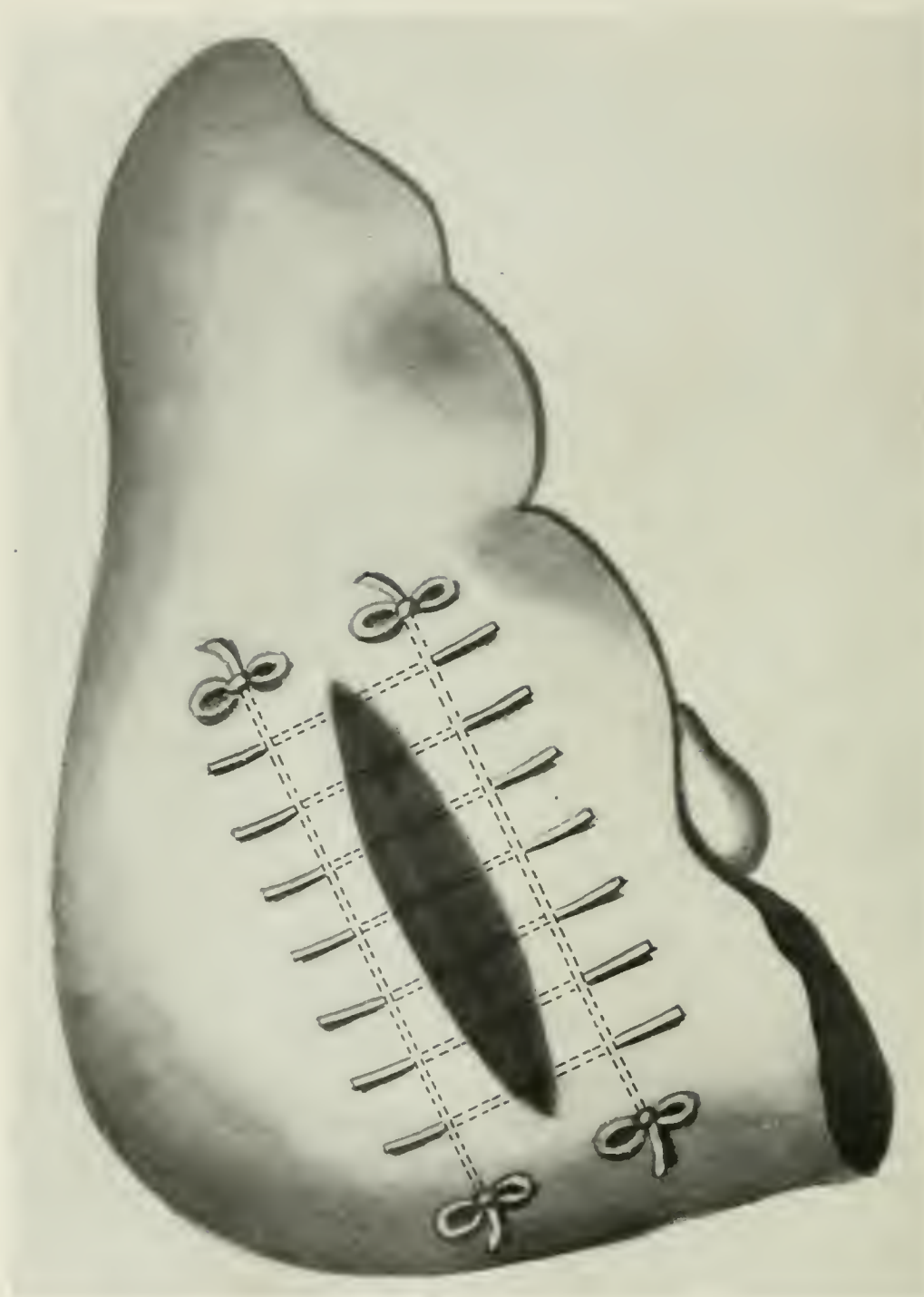
* Read before Iowa State Medical Society, May 17, 1907.

FIG. 1.



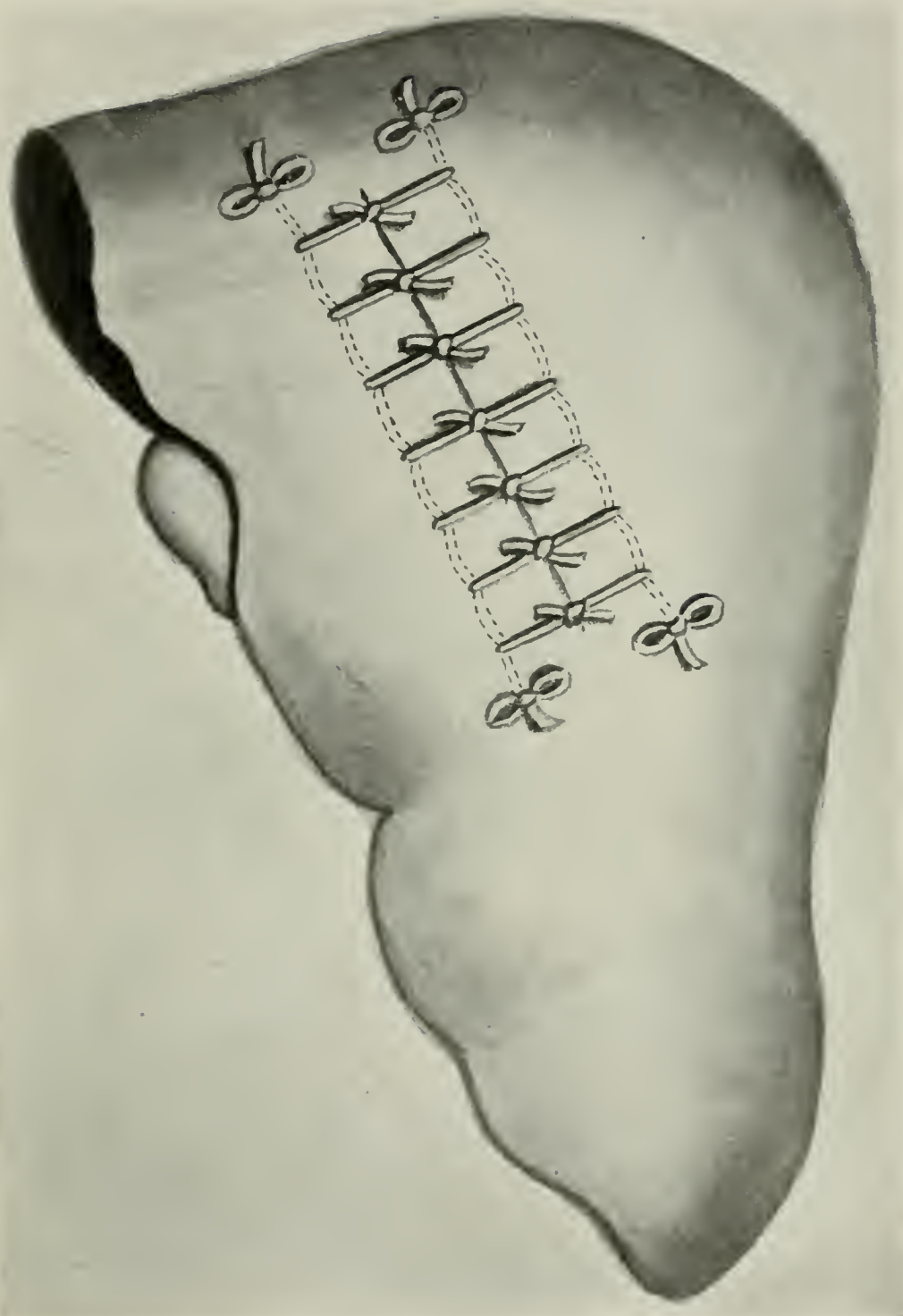
The sunken catgut strands in the tissue parallel to the wound to be sutured.

FIG. 2.



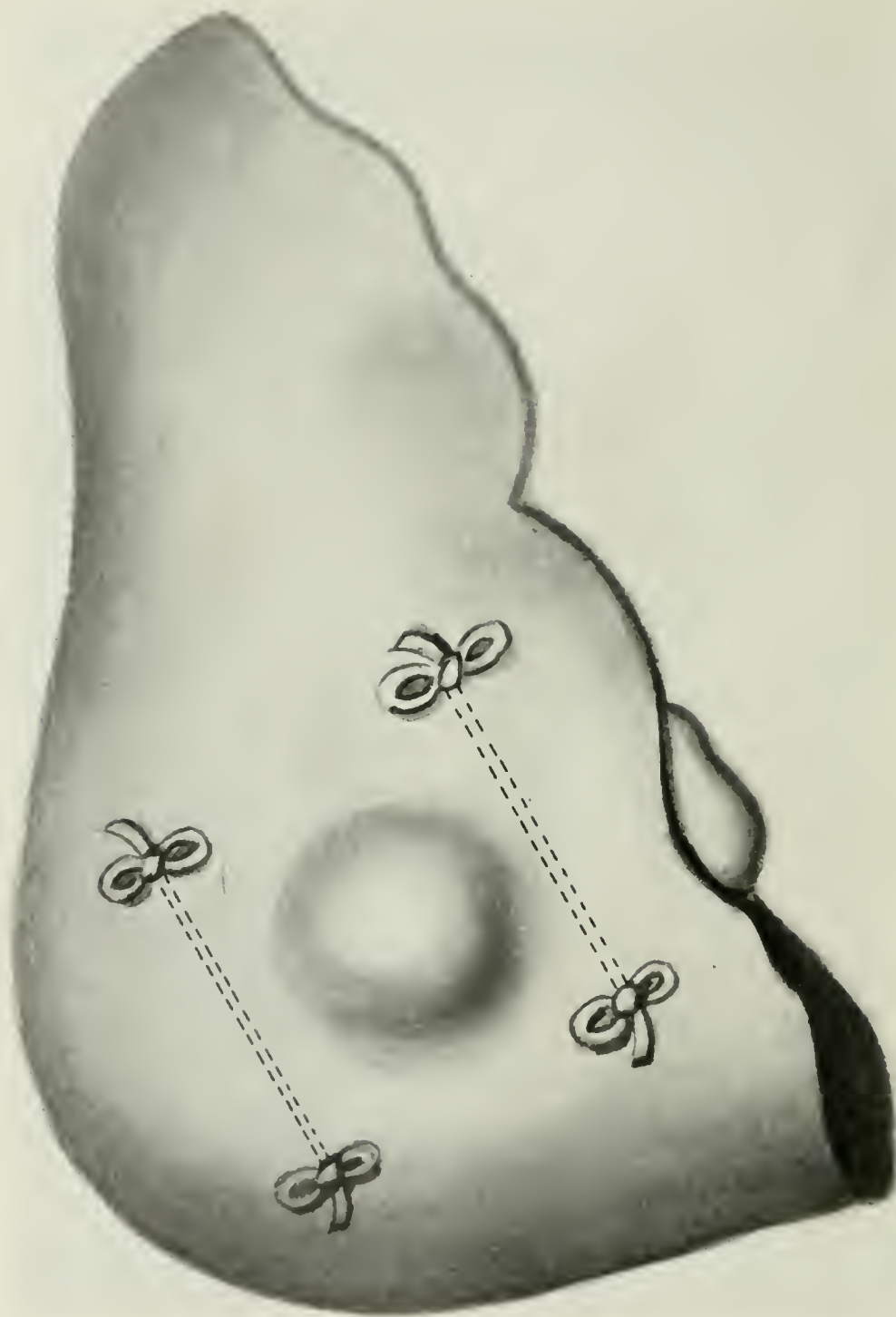
The transverse interrupted sutures introduced.

FIG. 3.



The transverse sutures tied.

FIG 4.



Long parallel sutures introduced as a preliminary to the excision of a tumor from the liver.

without the necessity for packing and will also permit the resection of large or small areas of tissue for the radical extirpation of liver tumors.

Parallel with the wound in the liver or with the area to be excised and about one half inch from its edge upon either side insert deeply through the liver substance by means of a large, round, blunt needle shown in figure 1, a strand of No. 3 catgut. These needles, as well as the small, blunt needle mentioned later, are modifications of Kousnietzoff's liver needles which have been so successfully used and have proven very satisfactory. These strands should enter the liver tissue about one inch beyond the edge of the wound, run deeply through the liver substance and emerge the same distance from the opposite end of the wound. The ends of these catgut strands are now fastened by drawing them up snugly and tying to either end of both strands a small ordinary skein of catgut, which presenting a broad surface against the liver tissue prevents the indrawing of the suture ends. Transverse interrupted sutures (Fig. 2) of No. 3 catgut are now introduced by means of a small, blunt needle, also shown in Fig. 1, in such a manner that they engage upon either side of the wound the buried long strand of catgut. These may be tied as rapidly as introduced and exerting their traction upon the buried long suture may be tied snugly (Fig. 3) ensuring hemostasis and coaptation without the danger of their cutting out.

When it is desired to remove a portion of the liver tissue carrying with it a tumor this may be done by excising between the buried long sutures (Fig. 4) a wedge-shaped ellipse of liver substance and introducing the transverse sutures as above described.

Hemorrhage during this procedure may be controlled either by manual pressure or by elastic ligature until the transverse sutures are tied when it will immediately cease.

If desired any large veins presenting along the cut surface may be tied as recommended by Keen by placing a ligature about them with a small needle carrying fine catgut which precaution in my experimental work I have found unnecessary.

I have not yet had an opportunity to employ this suture upon the human being but should not hesitate to rely upon it at the first opportunity. In many experiments upon dogs I have found that it was possible to remove various amounts of liver tissue up to one half of the organ beyond which amount I have not tried to go and also that hemorrhage from any sort of a wound large or small in the liver substance could be in this manner easily controlled.

As the material used in this suture is plain catgut which having served its purpose will be absorbed the necessity for an open wound, gauze packing, etc., may in most cases be eliminated.

I do not offer this method as one that is perfect nor do I care to make any extravagant claims for it as my experience with it is as yet too limited. I offer it with the hope that as opportunity permits you will try it and demonstrate its value or its shortcomings.

THE OPERATIVE TREATMENT OF CALCULI IMPACTED IN THE PELVIC PORTION OF THE URETER.

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THE operative treatment of stones impacted in the lower portion of the ureter has of late received a good deal of attention. During the last two years, I have operated on seven occasions at the London Hospital for the relief of this condition.

An investigation of the literature of the subject shows that the surgical treatment of impacted stone in the pelvic portion of the ureter is a comparatively recent achievement.

Fowler (in *Annals of Surgery*, 1904, XL. 943) gives a good account of the progress made in the operative treatment of these difficult cases. He states that Bardenheuer in 1882 was the first to remove a stone from the upper part of the ureter by the iliac extraperitoneal route. Even as late as 1898 the statement was made that stones impacted in the pelvic portion of the ureter were inaccessible to surgical treatment. Hurry Fenwick ("Obscure Diseases of Kidney," 1903, p. 151), however, removed a stone from the juxtavesical part of the right ureter by the perineal route in 1895. In 1892 Cabot ("International Journal of Medical Sciences," No. 103, p. 43) suggested that stones so placed could be removed by a modified Kraske operation, but the necessary severity of this procedure has condemned it as a routine method of treatment. Further Henry Morris (*Surgical Diseases of Kidney and Ureter*, 1901) showed that stones could be removed from this portion of the ureter in the female at any rate by a sacral route which did not involve any removal or division of the sacrum or coccyx.

Several recent writers have proved that stones impacted even in the portion of the ureter between the pelvic wall and the wall of the bladder can be removed by the inguinal extraperi-

toneal route. The difficulties of this operation however in a fat subject, and the fact that in the female the base of the broad ligament has to be encountered, are sufficient reasons for attempting some other means of access to this portion of the ureter. In certain cases where local removal is impracticable, stones can be displaced upwards owing to dilatation of the ureter above the site of impaction and they can then be removed by the inguinal route.

The extraction of a stone from the juxtavesical portion of the ureter has been carried out through the rectal wall on one occasion, the case was fatal and the operation is never likely to be repeated. A successful case of removal of a stone from the pelvic portion of the ureter by a transperitoneal operation is reported by Stewart,⁵ but in the light of recent experience this route is no longer practised. An extraperitoneal operation is the method of election in all cases owing to the great risk of leakage and peritoneal infection by the transperitoneal route.

The writer of this article has exposed the ureter from below by a pararectal operation on four different occasions and has successfully removed stones in three of these cases. In the fourth the ureter was exposed and thoroughly explored with a bougie from the kidney to the bladder, but the stone had probably been passed.

Statistics of recorded cases show that the juxtavesical portion of the ureter or that portion between the pelvic wall and the bladder is a comparatively common site for impaction of a ureteral stone.

Henry Morris (*loc. cit.*) in 45 cases found: 19 within 2 inches of the bladder; 15 close to the vesical wall; 11 at the level of the brim of the true pelvis.

Schenck⁶ in 1901 out of 84 cases, found that in 68 the site of impaction was stated as follows: 19 within 6 centimetres of the kidney; 8 at or near the brim of the pelvis; 41 within 2 inches of the vesical opening, *i.e.*, 50.6 per cent. of these cases were in this position.

Bovee⁷ collected 64 operations in which an impacted calculus was removed by the extraperitoneal route.

In 57 of these cases: 22 were found at the upper constriction; 17 at the pelvic brim; 18 close to the bladder wall.

The operative treatment of stone impacted in the upper portions of the ureter need not be considered at length as on this point there is unanimity of opinion. The portion of the ureter extending from the pelvis of the kidney down to the point where it leaves the lateral wall of the pelvis can be exposed with comparative ease by the lumbo ilio inguinal incision. The peritoneum is raised up and the ureter which always adheres to this structure is defined. In the male subject if not too fat the portion of ureter between the pelvic wall and bladder can also be exposed. In a fat subject this may be very difficult and in the female impossible owing to the broad ligament. In all cases when possible the stone should be displaced upwards and removed high up. It is not always necessary to make the lumbar incision, an inguinal incision as for exposing the external iliac vessels need only be employed. Again there is little difference of opinion as to the methods of reaching stones impacted in the vesical orifice of the ureter or in the portion which traverses the bladder wall. The object of this communication is to especially discuss the operative treatment of stones impacted in the so-called juxtavesical portion of the ureter, that is, a portion about 3 inches in length which extends between the bladder wall and the ischium. More especially when the high route or inguinal extraperitoneal method is difficult or actually impracticable.

CASE I, in my series, illustrates a third condition which renders an inguinal operation impossible for stones impacted in this part of the ureter. In this patient a stone had already been removed by the inguinal route and another had formed in situ, it was therefore impossible to again strip up the adherent peritoneum from the iliac fossa and brim of the pelvis.

The juxtavesical portion of the ureter is inaccessible from above in:

- (1) A male subject with a fat abdominal wall.
- (2) A female subject owing to the presence of the broad ligament.

(3) Cases where a stone has recurred in situ after the inguinal operation.

The alternative operations which have been employed for exposing this portion of the ureter are:

(1) Transperitoneal. (2) Perineal. (3) Parasacral or pararectal without removal of bone (*i. e.*, the operation performed on these four cases). (4) Parasacral or pararectal with removal of a portion of the sacrum or coccyx. (5) Vesical (with dilatation of the vesical orifice of the ureter). (6) Rectal route. (7) Vaginal route.

The criticism already applied to the transperitoneal route, namely, risk of leakage, more than ever applies to removal of stone by this method from this part of the canal.

The perineal route must be very difficult and has peculiar risks attached to it. There is real danger of wounding the rectum, hæmorrhage is usually free, the vesiculæ and vas deferens may be damaged and it is quite impossible to apply sutures to the ureteral wall and difficult to insert bougies afterwards. Notwithstanding the brilliant result in Mr. Hurry Fenwick's case already mentioned this operation will probably never become a popular one.

In the female the vaginal route is the operation for choice when a stone can be easily felt by the examining finger. The risks are small and the danger of a subsequent fistula is not great. If the ureter is not adherent it may be easily pulled down by a blunt hook and sutures applied if thought necessary. The rectal route is rightly condemned and requires no further comment.

The vesical route is very difficult and the extraction of stones by dilating the vesical orifice of the ureter hardly feasible unless they be either very close to or impacted in the bladder wall.

There remains for discussion the so-called posterior or inferior routes of access to this portion of the ureter.

The principle in these operations is to reach the ureter from below by opening up the pararectal subperitoneal tissue.

Mr. Henry Morris (*loc. cit.*) has shown that this is pos-

sible in the female, and this paper deals with four similar operations performed on male subjects.

The ureter was reached with ease in three out of the four cases. In the fourth much difficulty was experienced for special reasons which will be mentioned presently. It was not found necessary to remove any portion of the sacrum or coccyx. The operative procedure employed is not in the least a new one but followed the teaching of Henry Morris and other authorities supplemented by practice on the dead subject. The description of the operation employed in these four cases is as follows:

The patient is placed on the side opposite to that on which the stone is impacted. The semiprone position is employed with the knees well flexed. The pelvis is raised by a small sand bag. The edge of the coccyx on the affected side is well defined by palpation with the fingers from outside. An incision $3\frac{1}{2}$ inches in length is made, extending backwards from a point 2 inches from the posterior border of the anus. This incision is half an inch from and parallel with the edge of the coccyx, it passes upwards and outwards lying obliquely to the middle line of the body. The gluteus maximus muscle is exposed and its fibres completely divided for about two inches or more.

The great sacrosciatic ligament and the posterior portion of the ischio rectal fossa are thus exposed. The small and great sacrosciatic ligaments are next divided and the spine of the ischium must be clearly defined with the fingers. This bony point is the first important landmark in the operation.

The fibres of the coccygeus muscle and usually some of the posterior fibres of the levator ani come into view. The former are scratched through with a blunt dissector. The rectal fascia is next exposed and treated in the same manner. The subperitoneal space is then revealed, but the rectal wall itself is not defined.

The ureter is next sought for in the subperitoneal tissue. This is the most difficult part of the operation as the ureter remains closely connected to the peritoneum and is somewhat firmly embedded in the subperitoneal fat. It may also be surrounded by a plexus of vessels.

The position of the spine of the ischium is again noted and the ureter sought for lying about $\frac{3}{4}$ inches above the spine in the axis of the operation wound. The best method of searching for the ureter is to use two pairs of long dissecting forceps. The peritoneum and subperitoneal tissue should be caught by the one pair and pulled up from the depths of the cavity. By fixing the peritoneum in this manner the dissection is made much easier. If this precaution is not observed the peritoneum is easily stripped off the lateral wall of the pelvis and tends to sag further and further towards the opposite side and deeper from the surface.

If difficulty is still experienced in finding the ureter and a stone cannot be palpated by a finger passed into the wound deep pressure should be made by an assistant on the abdominal wall in the pelvic region.

Further it is especially important to avoid needless stripping up of the peritoneum as this opens up a greater area of subperitoneal space which may later become septic.

If the ureter is still hidden a search forwards towards the base of the bladder will expose the apex of the vesical seminalis and having defined this the ureter will be found lying close to its inner border.

When the ureter is found and the stone located the latter is if possible displaced to another part of the canal. A longitudinal incision is then made and the stone extracted. A ureteric bougie is then passed down to the bladder and upwards to the kidney. This procedure is important as a stricture may also be present. The opening in the ureter is then closed by fine absorbent catgut sutures inserted after the Lembert principle, the mucous coat must on no account be penetrated by these sutures. A drainage tube is then passed down to the site of the incision. The sacrosciatic ligaments are then sutured with chromic catgut, then the fibres of the gluteus maximus and finally the skin wound leaving an opening at one end for the tube. The opening in the ureter need not necessarily be sutured but in my cases the sutures were inserted without any difficulty.

THE AFTER EFFECTS OF THE OPERATION.

In each of these four cases some leakage of urine took place from the wound for a few days. With one exception the wounds healed rapidly and the tube sinus quickly closed.

In Case 4 some fresh leakage occurred later and the sinus reopened and discharged pus, but the dependent position of the track allowed natural drainage and checked any tendency to extension of suppuration.

The result of division of this small portion of the gluteus maximus was insignificant, some wasting of the posterior part of the muscle could be seen but in two of the patients, observed 12 months after the operation, no appreciable loss of muscular power was experienced.

The advantages of this operation:

(a) The abdominal wall is not incised and therefore the risk of a ventral hernia is absent.

(b) The ureter is directly approached from below and the great disadvantage of stripping up the peritoneum and opening up the retroperitoneal space is avoided.

(c) The hæmorrhage in this operation should be trifling as no vessels of any size are encountered.

(d) There is no risk of damage to the iliac vessels either by carelessly stripping up the peritoneum or later by the presence of the drainage tube.

(e) The position of the wound ensures perfect drainage in the recumbent position.

(f) In the inguinal operations this portion of the ureter lies at a greater depth from the skin surface especially in a fat subject. The actual depth from the surface at which the ureter lay in one of my patients was by measurement $3\frac{1}{2}$ inches.

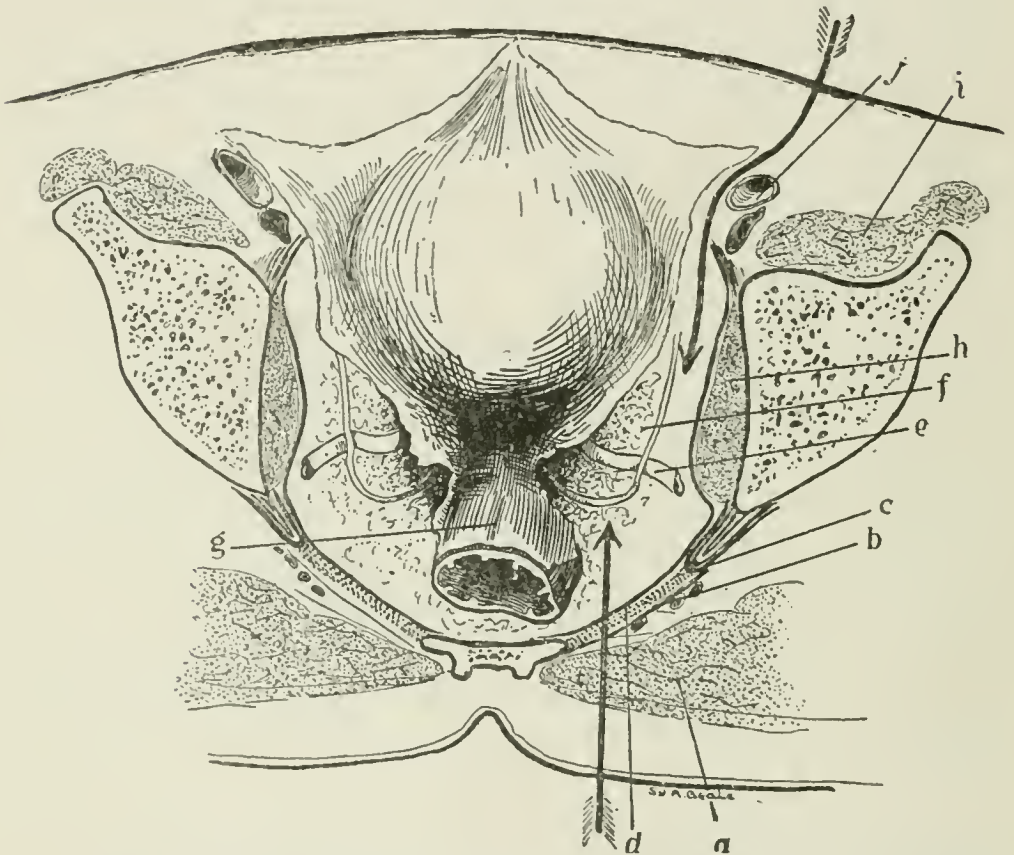
(g) The ureter can be pulled up within easy reach so that sutures can be introduced accurately without any difficulty.

If the stone cannot be felt there may be great difficulty in defining the ureter. In Case No. 3 where a small stone was fixed in the paraischial portion the ureter could not be defined until a transperitoneal exploration was also made. In Case

No. 4 on the other hand the ureter was easily found, although no stone was present. In Cases 1 and 2 no difficulty was experienced.

Figure 1 is a section made from a frozen pelvis. The section was made through the lower portion of the coccyx posteriorly and just above the pubes anteriorly.

FIGURE 1.



a, Gluteus maximus; *b*, sacrospinous ligaments; *c*, coccygeus muscle; *d*, rectal fascia; *e*, ureter; *f*, vas deferens; *g*, rectum; *h*, obturator externus; *i*, iliacus; *j*, ext. iliac vessels.

This section includes the tissues involved in both the inguinal and pararectal operations. The arrows show the paths taken in exposing the ureter by these two routes.

Figure 2.—This is a drawing made from a longitudinal section of the female pelvis by Mr. Arthur Keith. The specimen is in the Museum at the London Hospital Medical College.

The cervix uteri has been removed so as to expose the path of the ureter beneath the broad ligament.

The following is an abstract of the Cases on which this communication is based:

CASE I.—E.B., aged 21 was admitted into the London Hospital on January 6th, 1905. He gave a history extending over a period of two years of recurring attacks of right renal colic. He had never noticed any alteration in the urine.

A radiograph was taken and showed a distinct shadow in the right kidney just below the last rib.

On January 13th, 1905, a stone composed of uric acid and phosphates was removed from the cortex of the right kidney. A bougie was passed down the ureter into the bladder without encountering any obstacle. The wound was partially closed and an uneventful recovery followed. He left the Hospital on February 9th, 1905.

On August 21st, 1905, he was re-admitted with the following symptoms. Pain in the glans penis during the act of micturition. This commenced about 3 months after leaving the Hospital, and has continued on and off up to the present time. When the pain is severe he has increased frequency of micturition both during the night and day. He has never noticed any hæmaturia. In addition to the penile pain he has had aching in the right loin in the site of the scar.

On admission. The scar looked quite healthy. The right kidney could not be felt and was not tender even on deep palpation. There was no tenderness along the course of the ureter. A rectal examination revealed a tender point at the base of the bladder on the right side but a calculus could not be felt. A radiograph was taken and a distinct shadow could be seen in the right ureter apparently just above the right ischial spine. The urine was acid contained pus corpuscles, a small trace of albumen, no blood, no casts. The amount of urine passed per diem was 18 to 22 ounces.

On August 26th, 1905. An incision was made above and parallel with Poupart's ligament on the right side. The muscles of the abdominal wall were divided and the peritoneum stripped up from the right iliac fossa. The ureter was exposed and followed down as far as possible but the stone could not be felt. A small opening was made in the ureter and a probe was passed down. This was stopped apparently just outside the bladder wall.

A finger was then inserted into the rectum and the base of the bladder and lower end of the ureter pushed upwards. A small stone could then be easily felt. The ureter was traced further downwards after some difficulty and an attempt was made to displace the stone upwards but without success. An incision was then made over the impacted stone and it was extracted. The two openings made in the ureter were closed by fine silk sutures including the serous muscular coats only. The lower opening was closed after very great difficulty. A drainage tube was left in situ and the wound partially closed. A discharge of urine took place from the tube for a week. The tube was removed on September 4th and the patient left the Hospital well on September 23rd, 1905.

On February 23rd, 1906, the patient was re-admitted into the Hospital with recurrence of similar symptoms, namely, severe penile pain during micturition, slight increased frequency but no bleeding. The urine was found to contain albumen and pus in small quantities. A radiograph again showed a calculus in the right ureter apparently in the same position as the previous one.

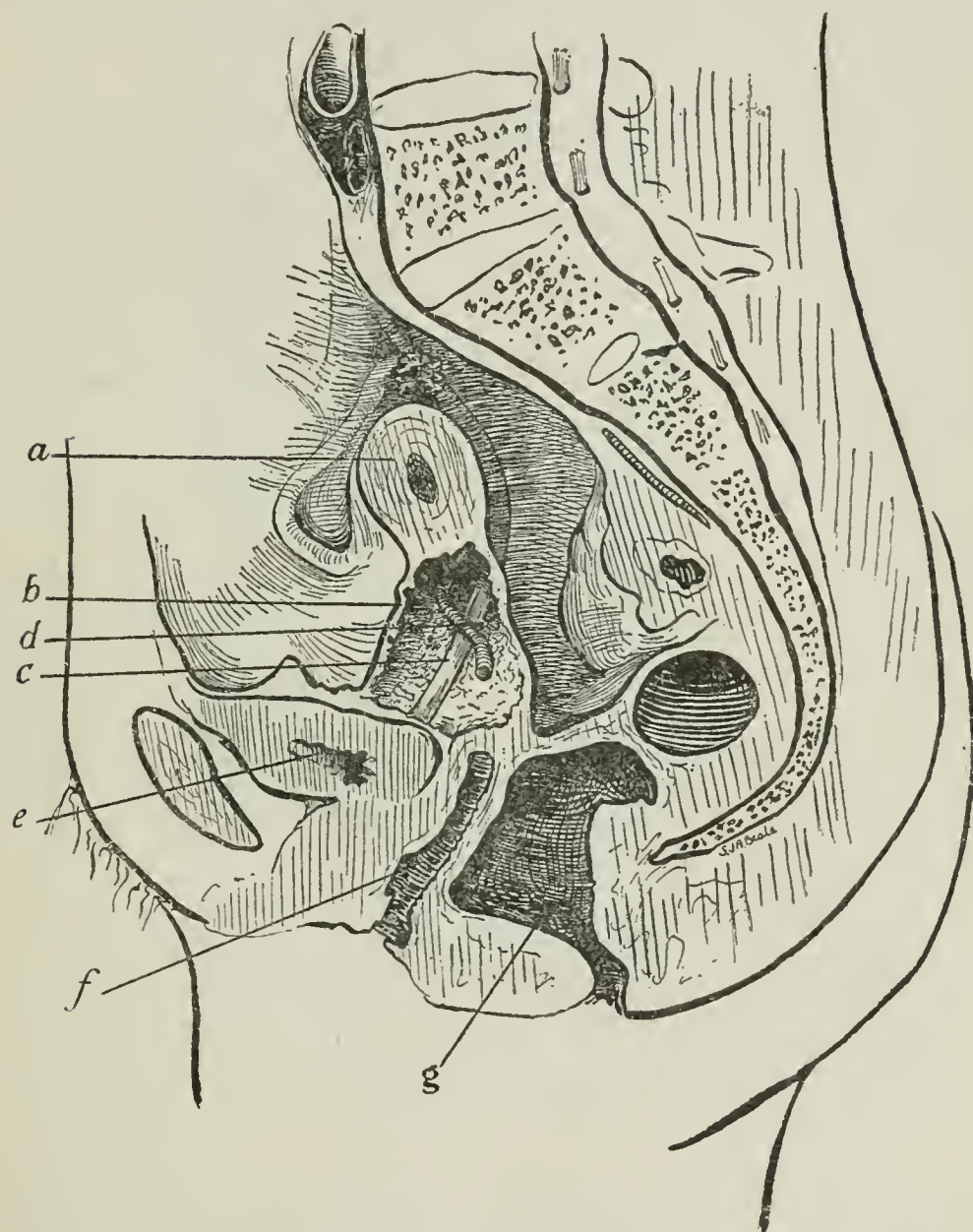
On March 9th, 1906, a transperitoneal operation was made to try and shift the stone upwards from the pelvis to the upper part of the ureter. The patient was placed in the high Trendelenberg position and the attempt was made through an incision in the right semilunar line. The stone, however, was firmly fixed and could not be shifted at all. An endeavor to restrip the peritoneum from the right iliac fossa proved futile as it was firmly bound down by adhesions from the previous operation. The abdominal wound was therefore closed and the patient sent back to bed.

On March 16th, 1906, the patient was again anæsthetized and the stone was removed by a pararectal operation as described above. There was little difficulty in the operation, the stone was found and the ureteral incision sutured with fine catgut sutures. The depth of the ureter from the surface in this case was measured and found to be $3\frac{1}{2}$ inches. A drainage tube was left in and the wound and muscles partially closed by sutures.

There was leakage of urine for 48 hours from the wound but never in any large amount. The wound healed well and the patient left the Hospital on April 13th. The calculus which was removed was composed of phosphates and in its centre was found a small silk suture evidently one of those introduced at the last

operation. Since this date the patient has passed two small phosphatic stones via the urethra after more or less severe attacks of colic. Each of these stones contained small silk sutures. The last of these was passed on February 5th, 1907.

FIGURE II.



a, body of uterus; *b*, broad ligament; *c*, ureter; *d*, uterine artery; *e*, bladder; *f*, vagina
g, rectum.

CASE II.—F.P., aged 10, was admitted into the Poplar Hospital on May 15th, 1906. For three months he had complained of recurring attacks of pain in the right loin and right side of

the abdomen. The attacks were severe and accompanied by hæmaturia. There was no pain in the penis but the pain during the height of the attacks radiated to the bladder, right groin and testicle.

A radiograph showed a well marked shadow in the region of the right kidney and another close to the bladder in the right ureter. The bladder had been sounded with a negative result. A stone could not be felt on rectal examination.

On May 26th, 1906, a stone was removed from the right ureter by a pararectal operation. The ureter was easily found as the stone could be felt in the bottom of the wound. The stone was extracted and the urethral opening sutured with fine catgut.

An incision was next made in the right lumbar region and a stone removed from the pelvis of the right kidney. The two operations took 45 minutes. There was a little leakage as usual from the pararectal incision for about five days. The two wounds healed well and the patient left the Hospital on June 24th.

Fig. 3 is a photograph taken three months after the operation. (Fig. 3.)

CASE III.—F.J., aged 35, was admitted into the London Hospital on January 16th, 1907. He complained of recurring attacks of severe colic on the right side. The first attack was in August, 1906. The attacks lasted from 3 to 5 days. He was quite free from pain in the intervals. On one occasion the pain radiated to the right testicle. He never had pain in the glans penis. Blood was never noticed in the urine and there was no frequency of micturition.

On October 10th an examination of the abdomen and by the rectum revealed nothing abnormal. The urine was normal. A radiograph was taken and a distinct shadow could be seen just below the pelvic brim on the right side. He was recommended to take large quantities of fluid in the hope that the stone would pass into the bladder.

On November 10th a second radiograph was taken. During this interval he had one further attack of severe colic. This radiograph appeared to show that the stone had become displaced downwards and was now lying just above the ischial spine.

He persevered with the palliative treatment and between this date and January 4th, 1907, he had four further attacks of colic. He had no increased frequency, hæmaturian or penile pain.

FIG. 3.



CASE II.—Photograph of scar left after the pararectal operation.

A third radiograph taken January 10th showed that the stone was in the same position. Operation was advised and performed on January 19th, 1907. The pararectal route was adopted as the stone was thought to be lodged in the juxta vesical part of the ureter. The pararectal space was opened up but the ureter could not be defined and no stone was felt. After a prolonged search a small incision was made in the right semilunar line and two fingers were inserted into the peritoneal cavity. The ureter was then palpated with two fingers in the pelvic cavity and one in the pararectal space. The ureter could thus be easily defined although no stone was felt, on tracing the ureter upwards a very small stone could be felt lying against the lateral wall of the pelvis above the ischial spine. The ureter was next defined from the pararectal wound assisted by the fingers in the abdominal cavity. A small incision was made in its wall and a probe passed upwards for $1\frac{1}{2}$ inch struck against the stone. A pair of urethral forceps were next inserted and pushed up the ureter and after several attempts a small rough oxalate stone was grasped and easily extracted.

The incision in the ureter was closed as before with fine catgut. The small incision in the right semilunar line was next closed and the parasacral incision partially closed. The after progress of this case was prolonged owing to late thrombosis occurring in the left femoral vein. The wound by the coccyx leaked urine for four days, then healed up slowly.

On February 10th signs of thrombosis developed in the left femoral vein and on February 27th patient suddenly developed symptoms of pulmonary embolism. This he recovered from but the thrombosis of the leg persisted.

On March 4th a fresh collection of pus developed in the track of the drainage tube in the parasacral wound. This was evacuated and after a few days the wound again closed. Further progress was uneventful.

The difficulties experienced in this case were entirely due to a wrong appreciation of the position of the calculus. It would certainly have been wiser to have approached the ureter in this case by the inguinal route. The patient was a stout muscular man and this added considerably to the depth of the ureter from the surface.

CASE IV.—W.M., aged 54, was admitted into the London

Hospital on August 4th, 1906. She complained of being ill for 5 or 6 years but much worse for the last 6 months. The chief symptoms are pain in the left loin radiating down to the hypogastrium and scalding pain in the urethra during micturition. There is much increase in frequency and blood was noticed in the urine on one occasion. An abdominal examination was negative. On vaginal examination a hard substance could be easily felt in the left fornix apparently close to the cervix uteri.

A radiograph showed two definite shadows in the region of the left kidney and a rather large elongated shadow in the pelvis apparently in the lower portion of the left ureter.

On August 13th, 1906, an anæsthetic was given and vaginal examination again revealed the presence of a stone in the lateral fornix. The bladder was cystoscoped. The left urethral orifice appeared to be somewhat dilated.

An incision was then made to the left of the cervix uteri through the vaginal wall. A stone was reached easily; it was firmly impacted in the ureter and during extraction was broken up into 3 pieces. A vaginal douche was given and dressings applied. A small gauze drain was inserted down to the ureteral incision. The patient was then turned on her right side and the left kidney exposed by the usual lumbar incision. The kidney was found considerably atrophied. At the lower part in the cortex were found two white cheesy masses embedded in smooth walled cavities, these were evacuated. Below these and deeper in the kidney substance was found a very friable calculus about the size of a small marble. This was removed. The cavities in the kidney were drained with gauze and a drainage tube passed down to the cortex. The lumbar wound was then partially closed.

After progress. The wound in the vagina apparently healed quickly as no urine escaped at all. The lumbar wound healed rapidly and no urine escaped. All the symptoms were relieved by this operation. The patient left the Hospital on September 4th, 1906.

Second operation. This patient was again admitted into the Hospital on April 2nd, 1907. Two months after leaving the Hospital the old pains returned again. She had severe burning pains like needle pricks on micturition. The pain was chiefly in the meatus and urethra. She also complained of pain in both loins

and in the hypogastrium. She had frequency every half hour night and day. No blood was noticed.

A vaginal examination revealed the presence of another stone in the same position as before and a radiograph corroborated this, two well marked elongated shadows could be seen. The kidney region showed nothing abnormal. Abdominal examination was negative.

On April 5th, 1907, the patient was operated upon a second time as follows: An incision was made in the left lumbar region along the side of the old scar. The kidney was exposed. It was adherent but was freed and removed without difficulty. The organ was very small and the vessels atrophied. No calculus was found.

The patient was next placed in the lithotomy position. An opening was made in the vaginal wall as before and two phosphatic stones removed from the left ureter. A probe was passed up the ureter. A vaginal douche was given and perineal dressings applied. No drain was used.

The after progress of this case was uneventful and the symptoms were again entirely relieved by the operation.

In this case it would probably have been better to have removed the kidney at the first operation and so avoided the fresh formation of stones.

CASE V.—S.L., aged 22, admitted into the London Hospital on February 14th, 1907.

History.—In July 1906 a stone was removed from the upper part of the left ureter at University College Hospital. In November 9th, 1906, he was admitted into the London Hospital and a stone was removed from the paraischial portion of the right ureter by the inguinal route. The wound drained insufficiently and leakage of urine was followed by spreading suppuration in the subperitoneal tissue. On December 17th, 1906, an abscess was opened in the right flank which had tracked up along the abdominal wall.

The patient left the Hospital soon after with wounds healed. The present symptoms commenced in January, 1907, in the left lumbar region aching in character sometimes radiating down along the course of the left ureter and involving the left testicle. The pain was always present but sharp exacerbations occurred two or three times a week. There was also pain in the glans penis

after micturition. There was no hæmaturia. The urine contained a trace of albumen and some pus.

A radiograph showed an indistinct shadow apparently due to a stone in the juxavesical portion of the left ureter.

On February 22nd, 1907, the pelvic portion of the left ureter was explored by the pararectal route. The ureter was found easily. It did not appear to be abnormal. A small longitudinal incision was made in its wall and a ureteric bougie passed down to the bladder and up to the pelvis of the left kidney. A stone could not be felt.

The ureter was then hooked up and two catgut sutures were inserted to close the wound. A small tube was left in situ and the muscles and skin united. Slight leakage of urine was noticed for two days. The tube was removed altogether on March 1st, that is 7 days after the operation and the wound healed rapidly. The patient left Hospital with complete relief of his symptoms.

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ORIGINAL MEMOIRS.

CARCINOMA OF THE ŒSOPHAGUS.

A CLINICAL AND PATHOLOGICAL STUDY FROM THE PATHOLOGICAL DEPARTMENT
OF THE ST. LOUIS UNIVERSITY MEDICAL SCHOOL.

BY M. G. SEELIG, M.D.,
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THE following case history with the appended autopsy findings is of more than usual interest, both from the clinical and pathological point of view:

L. H., 55 years old, of German nativity, a brewer by occupation, applied for treatment on July 4, 1906.

Family History.—Negative.

Past History.—Up to the onset of his present illness the patient was never sick. He has always had a chronic eczema of the face and neck, but has never been bothered much by it. He denies gonorrhœal and syphilitic infections.

Present History.—One year ago he noticed that he was gradually growing hoarse. This hoarseness did not follow a cold, and was accompanied neither by disturbance of the respiratory function nor by any laryngeal discomforts or pain. A few months after he first noticed the hoarseness he began to experience slight difficulty in deglutition, particularly on attempting to swallow an insufficiently masticated piece of meat. This difficulty in swallowing gradually grew more pronounced so that chopped meat and mashed potatoes, and finally only fluids could be taken. Of late even the swallowing of fluids has been accomplished with difficulty. He locates the obstruction just within the upper

aperture of the thorax. Hand in hand with the difficulty in deglutition there has been an increasing sense of weakness, and a progressive loss of weight from 210 to 150 pounds. Pain has never been a symptom of the disease and all other bodily functions except those of phonation and deglutition are normally performed. There is an occasional tendency to cough, with mucopurulent expectoration, which, however, has never been blood streaked.

Physical Examination.—Tall, emaciated individual. Scaly eczema of neck and both cheeks. Tongue moist and clean. Teeth and gums in good condition. Complexion that of pronounced secondary anemia. Pupils equal, reacting sharply to light and accommodation. A few small lymph nodes in both axillæ and groins. Voice harsh and rasping, distant, and at times purely sibilant in quality.

Neck and Throat.—There are no enlarged cervical lymph nodes, but just below the cricoid cartilage is a hard, infiltrated mass of tissue occupying the site of the isthmus of the thyroid gland. This mass, which moves up and down with the trachea on deglutition, feels like a calcified thyroid isthmus, the skin over it being freely movable. No tracheal displacement or tracheal tug. Laryngoscopic examination shows the left vocal cord to lie in the cadaveric position, and not to participate in phonation. Attempts to swallow water are followed by regurgitation of some of the fluid through the nose, the noise of the regurgitation rendering it impossible to time the swallowing sounds by auscultation.

Thorax.—The chest is distinctly barrel-shaped, and expansion, on deep inspiration is minimal. Breathing, markedly abdominal in character, is aided perceptibly by the accessory muscles of respiration. The percussion note over the entire anterior and posterior aspect of both chests is pronouncedly tympanitic. Auscultation discloses numerous sibilant and sonorous râles over both chests, together with a prolonged expiratory murmur. The breath sounds at both bases, posteriorly, are very distant.

Heart.—It is impossible to mark out the heart borders, owing to the tympany of the overlapping emphysematous lungs. There is a soft blowing systolic murmur over the aortic valve. Neither the second aortic nor the second pulmonary sounds are exaggerated, but the sounds both at the base and at the apex are weak.

The pulse is weak, beats 76 times to the minute, and shows a pronounced tendency to intermit a beat every fourth or fifth cycle. The left radial pulse seems to be slightly weaker than the right, and to be a bit delayed. The radials are distinctly sclerotic, and the tension within them is higher than normal. The temporal vessels are tortuous and hard. There is no visible pulsation nor palpable thrill over the cardiac area.

Abdomen.—Markedly carinated. Palpation and percussion negative.

Extremities.—Negative.

Urine.—Acid. Sp. grav. 1030. Trace of albumen. Few hyalogramular casts.

Here then was a patient whose history suggested both an aortic aneurysm and a neoplasm of the Œsophagus. The clearly defined onset with an involvement of the recurrent laryngeal nerve, spoke in favor of aneurysm, whereas the progressive dysphagia, to the point of complete obstruction, and the pronounced cachexia spoke for neoplasm. It was impossible to elicit any signs that would absolutely confirm the diagnosis one way or the other. Dr. W. E. Sauer attempted to establish the presence of a new growth by means of the Œsophagoscope, but was unable to do so, owing to the severe dyspnœa and cyanosis caused by the introduction of the instrument. The absence of pulsation, thrill and tracheal tug, combined with the impossibility of percussing out the area of heart dullness, owing to the pulmonary emphysema, rendered it impossible to make a positive diagnosis of aneurysm.

In the hope of securing some data that might aid in differentiating between cancer of the Œsophagus, and aneurysm of the aorta, the literature was searched for cases similar to the one under observation, the search resulting in the discovery of not a few cases in which it was impossible to differentiate between the two conditions. Kuchen¹ reports two cases of carcinoma of the Œsophagus in which the diagnosis of aneurysm of the aorta was made, and in which the correct diagnosis was not even suspected until it was disclosed by autopsy. The French clinician Carrière² made an exactly similar error, and the great German clinician Traube³ made a similar mistake. Both Carrière and Traube were aware that the condition

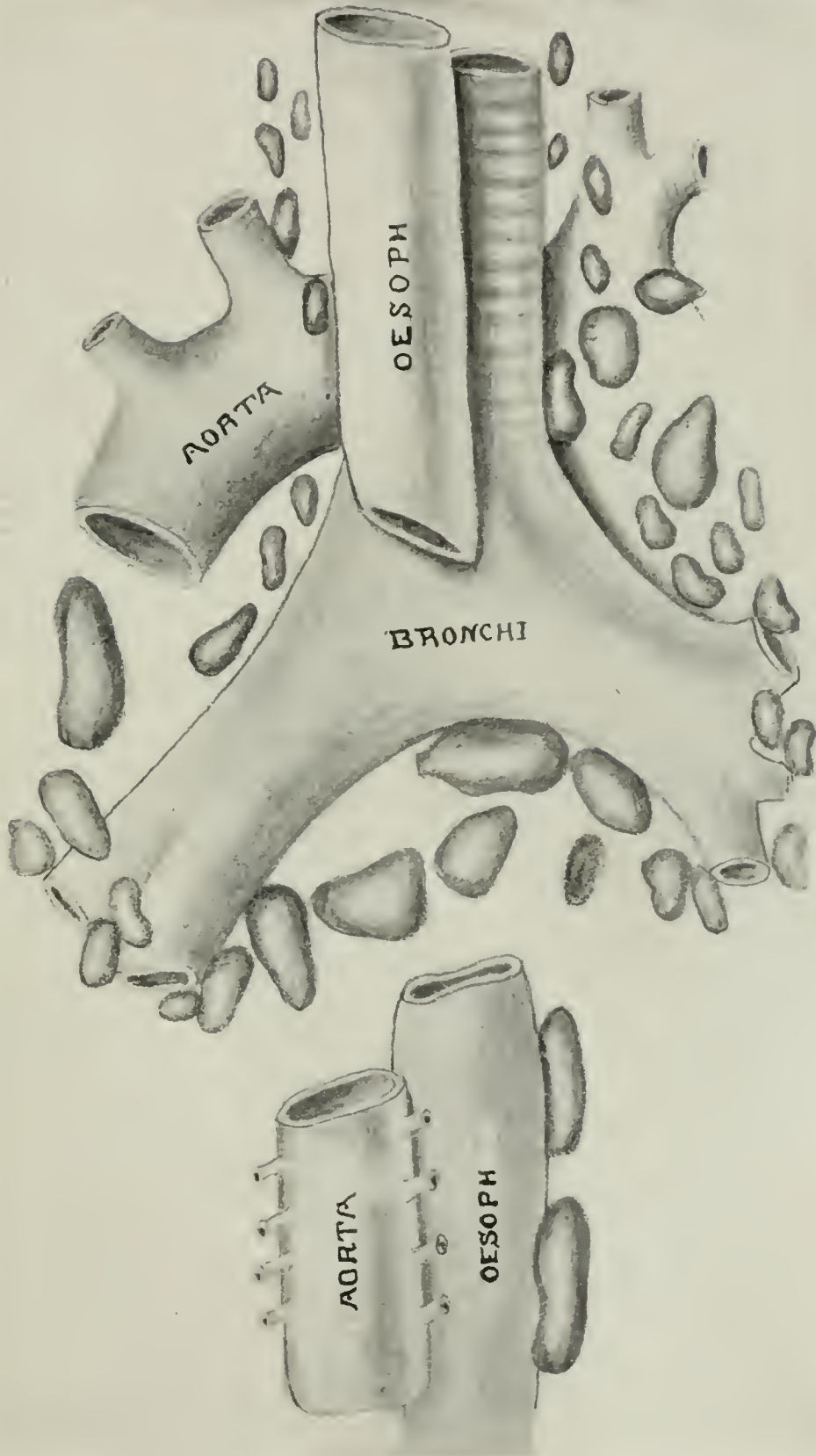
confronting them might be either aortic aneurysm or œsophageal new growth; but they made a positive diagnosis of aneurysm, only to find out their mistake, at autopsy. Gebauer⁴ reports a similar experience, as does also Kirchgaesser,⁵ and in our own country, Snow.⁶

If one will bear in mind the intimate relationship existing between the œsophagus and the lymphatic apparatus of the mediastinum, he will readily perceive how two conditions so diverse as carcinoma of the œsophagus and aneurysm of the aorta may cause almost identical symptoms. Fig. 1 represents the arrangements of the lymph nodes in the mediastinum that act as the first relays from the œsophageal lymph vessels. (See also "Ueber die Lymphgefäesse des Œsophagus," H. Sakata, Mit. a.d. Grenz. d. Med. & Chir. BXI. H. S., 1903.) These nodes are in actual contact with the œsophagus, and as a result, secondary involvement of them occurs very early after the invasion of the œsophagus by carcinoma. Such being the case we have a tumor growth started in the mediastinum which may cause all the symptoms and physical signs that are ordinarily caused by an aneurysm. Moreover, this mediastinal tumor may develop so much more rapidly than does the primary tumor of the œsophagus, as to give pronounced intrathoracic symptoms before there are any signs of obstruction of the lumen of the œsophagus. Naturally these symptoms are due to pressure on the mediastinal organs, and are therefore identical with the symptoms caused by pressure of an aneurysm on these same structures.

Pain (scapulo-humeral, scapulo-cervical, or intercostal) is a characteristic feature of aneurysm, supposed by Fraenkel⁷ to be due to pressure irritation of branches of the cardiac plexus ramifying in the periaortic connective tissue. But both Kucken (l.c.) and v. Ziemssen⁸ state that carcinoma of the œsophagus may be accompanied by severe, spontaneous pain, simulating in every detail the pain caused by aneurysm.

Dyspnœa, which is a fairly constant sign accompanying aneurysm is almost as constant a characteristic of carcinoma of the œsophagus. This symptom, just as is the case with the

FIG. 1.



Arrangement of the tracheo bronchial lymph nodes, after Hallé, in Poirier and Cuneo
("The Lymphatics." Chicago, 1904).

symptom of pain, is referable to pressure by either the aneurysm or the mediastinal metastasis from the œsophageal new growth, on the bronchi or trachea.

Involvement of the recurrent laryngeal is usually regarded as a strongly confirmatory sign of aortic aneurysm; but such an assumption is not warranted by facts. For example, Schech⁹ collected 42 cases of paralysis of this nerve, and in the series, he found that 5 cases were due to aneurysm of the aorta, 4 to carcinoma of the œsophagus, and 3 to mediastinal and pulmonary tumors. These figures and similar ones collected by Hampeln¹⁰ and Avellis¹¹ illustrate of how little aid the symptom of recurrent laryngeal paralysis is, in differentiating between the two conditions. Ehret¹² cites a case of carcinoma of the œsophagus in which the only symptom of importance was hoarseness, due to involvement of the recurrent laryngeal nerve. It has been suggested that in aneurysm the degree of hoarseness varies from time to time, owing to slight changes in the position of the aneurysmal sac, whereas in carcinoma of the œsophagus, the paralysis is a constantly progressive one. But even this distinction does not hold always, for in the case cited by Kucken (l.c.) varying degrees of hoarseness were caused by an œsophageal tumor, the recurrent laryngeal nerve not being directly involved in the mediastinal metastasis, being encroached upon merely by a local œdema, which varied from time to time, and which was caused by the presence of the new growth in the immediate neighborhood.

Dysphagia very naturally suggests that we are dealing with a tumor of the œsophagus. Lebert,¹³ however, states that in one third of all cases of aneurysm of the aorta, the œsophagus is compressed sufficiently to cause dysphagia. Even if the sac does not press directly on the œsophagus it can cause dysphagia by pressure on the vagus and its œsophageal branches. It is also a fact that a cancer of the œsophagus may grow only in the long axis of the tube, so that it causes no obstruction; or the growth may extend around the lumen of the œsophagus and be ulcerated sufficiently to preserve a free passageway for food.

Even the presence of a well marked cachexia does not add very strong corroborative evidence of a malignant neoplasm, for we are obliged to express our knowledge of cachexia in terms of a secondary anæmia, and a large proportion of all patients suffering with aneurysm of the aorta show a well pronounced secondary anæmia, due to a complicating nephritis, or endarteritis.

Thus we see, that all the cardinal signs of both conditions may fail to lead to a correct conclusion. A few years ago, it was hoped that the use of the X-ray would enable us to differentiate between aneurysm and carcinoma of the œsophagus with a degree of absolute surety, but Kuchen's two cases (l.c.), Kirchgaesser's case (l.c.) and my case illustrate the fact that this hope was baseless. Fig. 2 shows an X-ray of the thorax of my patient. The shadow (outlined with dotted white line) is strikingly similar to the outlines of various aortic aneurysms of the aorta pictured in Walsham and Orton's work¹⁴ and by Stover and Hall.¹⁵ Moreover, the lighter shadow seen between the two dotted lines at the left margin of the outline represent pulsation, which was also clearly seen through the fluoroscope. In Kuchen's and Kirchgaesser's cases the diagnosis of aneurysm was falsely based on a similar X-ray picture of a pulsating tumor. In reality, the shadow represents the mediastinal mass of new growth to which pulsation is transmitted by the underlying aorta. I am indebted to Dr. R. D. Carman both for the excellence of the X-ray work, and for many valuable suggestions in interpreting the X-ray findings.

A consideration of the conflicting testimony offered by these various subjective and objective signs fully substantiates the statement of Kuchen that great, and often insurmountable difficulties in diagnosis attend cases of carcinoma of the œsophagus when the growth is situated in the thoracic portion of this viscus, and particularly when there is an early involvement of the mediastinal connective tissue. In the particular case under discussion, Dr. Iralsen who had referred the patient to me, Dr. Sauer who also examined the patient, and I myself

FIG. 2.



X-Ray of mediastinal metastasis from an intra oesophageal carcinoma. Shadow of the heart fuses with the shadow of the new growth. Lighter shadow between the dotted lines on the left represents pulsation of the mass transmitted by the underlying aorta.

inclined most strongly to the diagnosis of carcinoma, chiefly on account of the complete œsophageal obstruction.

The patient consented willingly to the proposal that a permanent gastric fistula be made, and agreed to enter the hospital within a week. At my first hospital visit to him a week after my first examination, he informed me that for two days past he had been able to swallow with perfect ease, that he had even tested his swallowing capacity by eating green corn, and stated that he was able to swallow whole mouthfuls of unmasticated kernels without the slightest difficulty. This ability to swallow returned suddenly as he was attempting to eat a piece of meat by way of experiment. The patient himself was hopeful that this fact would render the operation unnecessary, but we construed it to be the only one definite sign that made the diagnosis of carcinoma almost certain. The dysphagia accompanying an aortic aneurysm may vary in degree, as we have seen above, dependent upon slight changes in the position of the aneurysmal sac, but such changes in position never lead to a sudden complete restoration of the lumen of the œsophagus. Such an occurrence as this must be dependent upon a diminution in the size of the compressing sac, due to sudden rupture or perforation, phenomena which give rise to serious general symptoms. Our patient experienced no threatening symptoms, merely passing quietly from a state of complete dysphagia, to one of unimpeded swallowing, due, we thought, to ulceration of an obstructing œsophageal tumor.

Considering the restored function of swallowing as a confirmatory sign of carcinoma of the œsophagus, we performed a typical Senn gastrostomy under $\frac{1}{2}$ per cent. cocaine local anæsthesia. The operation was done on the basis that the new growth would be sure to obstruct the œsophagus again, at a later date, when perhaps the condition of the patient would be such as to preclude the idea of operative interference. The operation disclosed a markedly contracted stomach, but there was no demonstrable evidence of new growth either in the abdominal portion of the œsophagus, or in the cardiac end of the stomach. The patient left the hospital on the tenth day after the operation with a thoroughly efficient gastric fistula.

The subsequent course of the disease was marked by a transitory gain in weight and strength, due to the ability to take more nourishment. After the elapse of a month, however, weak-

ness began to be a pronounced symptom; and five weeks after the operation the patient was obliged to take to his bed. Up to this time he ate freely of all varieties of food. Gradually, signs of obstruction reappeared and progressed so that six weeks after operation the patient was unable to swallow fluids. At this same time a distressing cough developed, accompanied by a very foul muco purulent expectoration. The weakness grew more and more profound despite frequent feedings through the fistula, and death supervened eight weeks after operation.

The autopsy, performed six hours after death by Dr. D. L. Harris, disclosed nothing of importance except in the thorax, therefore only that part of the protocol relating to the mediastinal structures will be stated: The entire mediastinum, from the upper aperture of the thorax down to the diaphragm was filled with a dense nodular mass, slightly fusiform in shape, the greatest diameter of the spindle being posterior to the fourth sternocostal articulations. This mass, which was a pearl gray in color, extended through the upper outlet of the thorax into the root of the neck, where it seemed to end by infiltrating the isthmus of the thyroid gland. Within the chest, the mass was fused with the lungs at their roots, but throughout the rest of its extent it was not intimately attached to the lungs. The whole mass which was removed in connection with the neck organs, is shown in Fig. 3. Six cm. below the laryngeal aperture, there is an irregular cavity the size of a small hen's egg opening into the anterior wall of the œsophagus. The walls of this cavity, lined with a foul, greenish-black, necrotic membrane, are made up of the jagged, eroded remains of six or eight tracheal rings on the right, and by tumor mass on all other sides. Six cm. below this cavity there is another one of exactly the same character, except that it has no tracheal remains in its makeup, and is smaller in extent as a result of not having ulcerated so deeply. This lower cavity has not ulcerated into the mediastinum. Extending from the upper to the lower cavity, is a chain of markedly enlarged firm anthracotic pericœsophageal lymph nodes, which on section show unmistakable evidences of invasion by new growth. Sections made from the walls of both cavities, from the isthmus of the thyroid, from the mass of mediastinal tissue, and from the pericœsophageal lymph nodes all showed typical squamous cell carcinoma (epithelioma).

FIG. 3.



Neck organs, œsophagus and mediastinal metastasis, showing two ulcerating epitheliomata of the œsophagus. The upper ulcer has eroded and destroyed most of the trachea.

These findings, although they confirmed the diagnosis of an obstructing carcinoma of the œsophagus, were surprising in that they disclosed a second unsuspected tumor at the lower end of the viscus. The presence of this second tumor immediately suggested the possibility of determining whether or not we were dealing with two primary tumors of the œsophagus, and at the same time of determining along what courses metastases occur in an œsophagus that is the seat of multiple tumors.

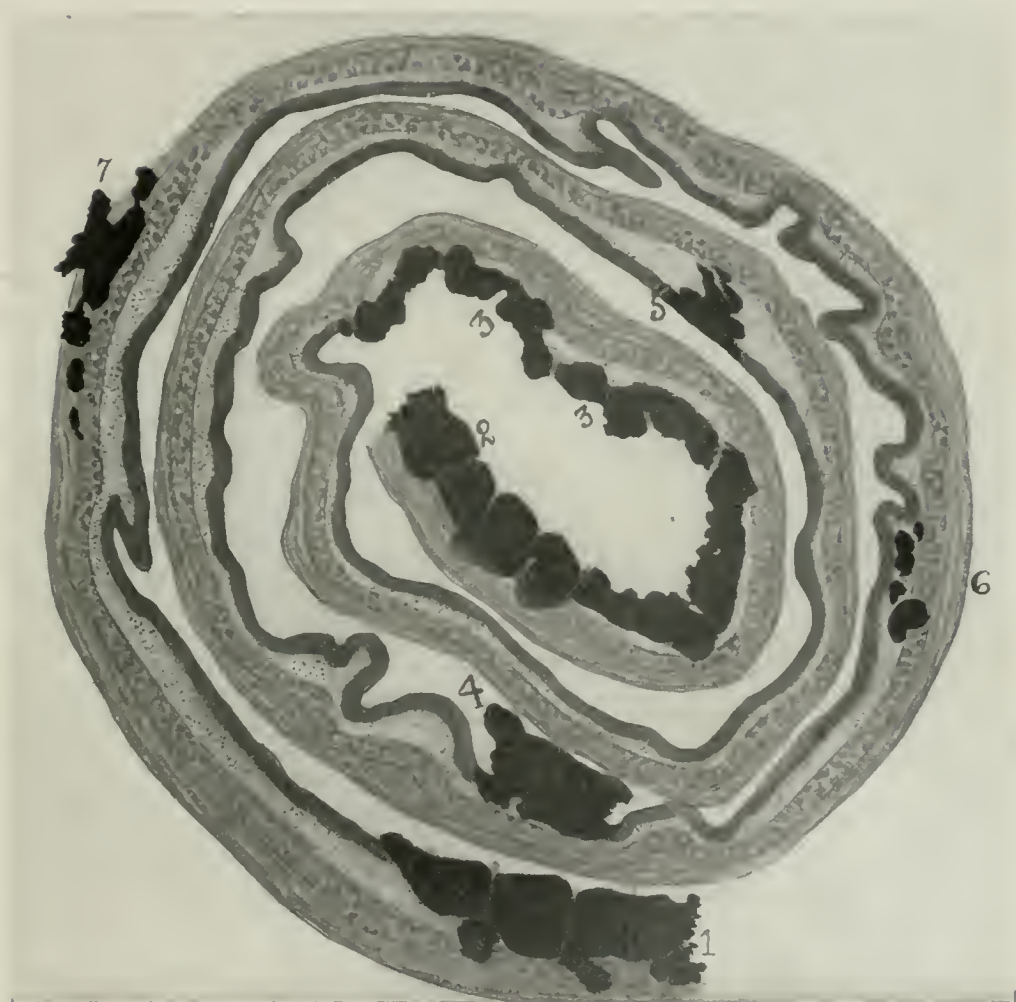
As regards the first problem, namely, whether the two tumors were primary or not, it is practically impossible to show that two morphologically identical tumors occurring in the same organ, are primary tumors. Had the upper tumor been a squamous cell carcinoma, and the lower one a cylindrical cell carcinoma, one would have been fairly well justified in pronouncing them to be two primary tumors. As the case stood, however, the rational assumption was that the lower tumor was secondary to the upper one, for it was smaller in size, less widely surrounded by dense extra œsophageal new growth, and less extensively ulcerating. Any one attempting to prove that these two tumors were both primary would have to bear in mind that there are similar cases quoted in literature, in which it was impossible to prove this point (Beck¹⁶) and that pathologists contend that a diagnosis of multiple primary tumors should only be made after excluding every possibility of any type of metastasis. Bucher¹⁷ and Billroth¹⁸ went even further than this, in claiming that a diagnosis of multiple primary tumors may be made only when:

1. The tumors have different histological structures.
2. Each tumor has a genetic relationship with the tissue in which it is growing.
3. Each tumor makes its own metastases.

Assuming then, that the lower tumor was a secondary growth, the problem as to how it originated remained to be solved. In order to solve it, it was necessary to dissect the œsophagus out of the bed of the new growth in which it lay, preparatory to making a serial section study of the entire organ. Very little dissection was necessary, for the œsophagus was

adherent to the bed of new growth only at the margins of the upper and lower ulcers. After this dissection was accomplished, the œsophagus (which had previously been opened down the middle line anteriorly) consisted of a ribbon of tissue 5 inches long, $1\frac{1}{4}$ inches wide, and about 1-10 of an inch thick. In order to avoid working with the enormous number of sections that would have resulted from cutting this strip of tissue transversely throughout its whole length, the strip was rolled upon itself much as a piece of dough is rolled to make a "jelly roll." With the strip held in this form by means of a piece of thread tied around it, it was fixed, hardened, and embedded. Fig. 4 is a diagrammatic representation of sections cut through the rolled up strip. The jet black coloring, represents deposits of new growth. No attempt is made to picture the histological structure of the coats of the œsophagus, or of the new growth itself; but the black deposits are exact reproductions in outline of various types of metastases that were met with, in looking over all the sections. The centre of the spiral strip represents the tumor that was situated at the upper end of the œsophagus, and is labeled 2. 1 shows the tumor that was situated at the lower end of the œsophagus. 3 represents a type of growth by continuity, extending down the œsophagus from the primary tumor. 4 is a small polypoid tumor which has all the characteristics of an implantation metastasis on the mucosa. This small tumor dips well down in the submucosa, but has grown most actively out into the lumen of the œsophagus. 5 represents a similar small metastasis which, however, instead of growing into the lumen, has grown outward toward the muscularis by means of two or three tongue shaped processes. 6 shows a metastasis confined exclusively to the submucosa and evidently originating in some of the lymph spaces of this coat of the œsophagus. 7 represents a deposit that grew into the lymph spaces of the muscularis from the outlying mass of carcinomatous tissue. Among all of the sections examined I could find none that showed lymph vessels crowded with squamous epithelial cells, so it was impossible to trace any of the metastases back to their original source

FIG. 4



Diagrammatic representation of the various types of metastases in a case of multiple carcinoma of the oesophagus (see text for description).

through a series of sections. Hundreds of sections were examined without finding in them any evidence whatsoever of metastases, and no single section contained more than one type of metastasization. For the sake of convenience all the types of metastases found are represented on one chart.

This work was done because I could not find a detailed study of the course along which metastases occur in the œsophagus. An encyclopedic work, such as Borst's "*Geschwulstlehre*," merely makes scant mention of the fact that there may be variously distributed intra-œsophageal metastases, whereas most of the larger works on surgery do not say even as much as that. It was not hoped that any definite scheme could be demonstrated whereby either the occurrence or route of intra-œsophageal spread of new growth could be explained. The whole question of metastases formation is still too much involved to admit of the deduction of any firm and fast laws. For example, Bucher (l.c.) contends, in a lengthy and learned article, that we are never justified in calling a small deposit (such as No. 4 and Fig. 3) an implantation metastasis, until every other possible method of metastasization has been ruled out. He believes that most of the so-called implantation metastases are, in reality, metastases that have occurred by retrograde lymph transport. Carmalt¹⁹ also speaks of the great difficulty of proving that a small metastasis in the œsophagus is in reality an implantation growth. He mentions the possibility of a particle of the epithelial lining becoming detached high up, and clinging so closely to a spot lower down that it presents all the appearances of an epithelial new growth. In our own case this is surely not true, for the submucosa is invaded by the small metastasis.

The study of the foregoing case demonstrated the difficulty of differentiating aneurysm of the aorta from carcinoma of the œsophagus by means of clinical data, illustrated the formation of multiple metastases in the œsophagus, and suggested that these multiple metastases may occur (a) by implantation, (b) through the lymph spaces in the submucosa, (c) by extension into the œsophagus from a mediastinal

metastasis, (d) by continuous growth above the lymph spaces of the mucosa, and (e) through the lymph spaces of the muscularis.

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⁸ v. Ziemssen, *Handbuch. d. Spec. Path. und Ther.*, Bd. vii. 1.

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¹⁷ Bucher, *Beit. z. Path. Anat.*, B. xiv.

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¹⁹ Carmalt, *Virch. Arch.*, B. 55.

TONSILLAR HEMORRHAGE AND ITS SURGICAL TREATMENT.

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FEW operations in surgery are so generally done badly as those upon the tonsils. Tonsillotomy is an easy but an utterly unjustifiable operation. Tonsillectomy is an exceedingly difficult operation to do ideally. Personally, the author is satisfied with but few of his tonsillectomies.

Nearly all operators at the present day slice off the projecting portion of the tonsil with a tonsillotome, apparently with the mistaken idea that the object is to rid the patient's throat of the mechanical obstruction to the passage of air caused by this projecting portion. Such an operation seals up the glandular tissue of the deeper portion of the tonsil under bands of cicatricial tissue which forever will interfere with throwing off of leucocytes, secretions, epithelial and other debris which will for years continue to be produced if any glandular tissue be left behind. If the patient has had periodical attacks of acute tonsillitis, he will have them more often than before. Patients frequently allude to such a case when tonsillectomy is proposed, mentioning the fact that the patient was made worse instead of better. One of the reasons why most operators hesitate to remove all of the tonsil is the fear of hemorrhage. As a matter of fact, hemorrhage is much more likely to occur after partial than after complete removal, for the vessels of the diseased glandular and cicatricial tissues do not retract as do those of the normal tissues in the bed of the tonsil. However, it is not on this account that tonsillectomy is urged in preference to tonsillotomy. "Rheumatism," infective arthritis, endocarditis, tuberculosis and a host of other ills that modern research has traced in many instances to the tonsils are made worse or their occurrence is rendered more likely by incomplete removal.

The proper and surgical way to remove the tonsil is to dissect it out completely capsule and all clear down to its bed of muscular tissue, and then immediately deal with the hemorrhage by twisting the vessels with long hemostats. Oozing of more than a few minutes duration after tonsillectomy is exceedingly rare. Dozens of times the author has been called in consultation where the bleeding was said to be an oozing and he has found upon lifting forward the anterior pillar an artery spurting. If the pillar was allowed to fall back into place the spurting jet struck against the posterior surface of the pillar and, flowing over the tonsillar wound, simulated an oozing from the wound so closely that any one who did not take the precaution to lift the anterior pillar would never suspect the source of bleeding.

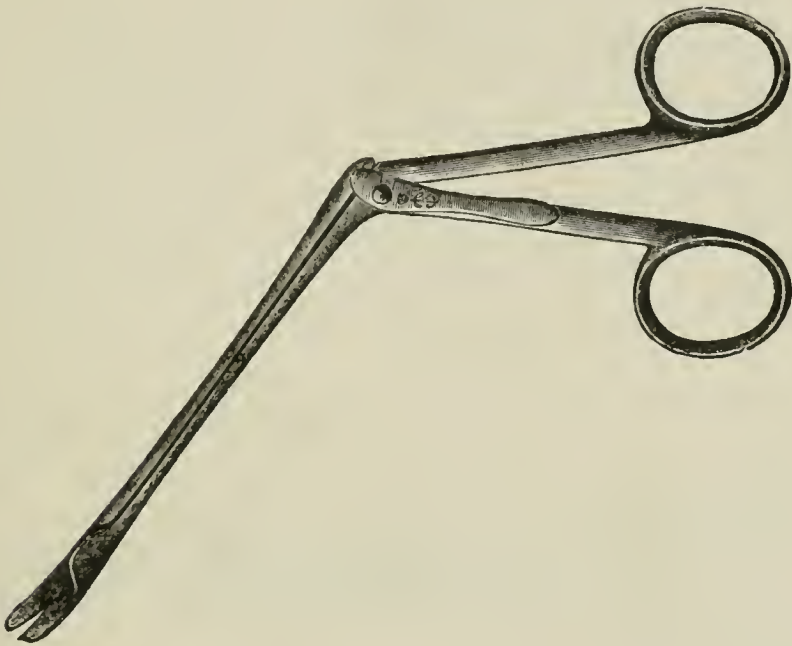
Oozing is simulated in another way. If spurting arteries and bleeding veins, be not twisted, as they should be, promptly after the removal of the tonsil, some of these vessels may partially retract, yet not sufficiently to stop bleeding, and being covered with a layer of fresh clot, may keep on bleeding for hours in what seems to be an oozing. Had torsion with hemostats been promptly applied when the tonsil was removed there would have been no oozing. Vessels too small to be seen and twisted cannot bleed more than a short time, except in cases with abnormal blood as in hemophilia, or with abnormal vessels as in general arterial changes, or local changes due to disease or its products in the tonsillar tissue. Obviously, the latter cannot be a factor if the tonsil be entirely removed. The snare is apt temporarily to close the vessel mouths which later will open owing to mechanical movements of the musculature surrounding the wound. It is far better to do a clean cutting surgical operation, promptly followed by surgical hemostasis with hemostats promptly applied to all bleeding vessels while they are readily located by their blood streams. If the anterior pillar be retracted the vessels can always be seen after any tonsillectomy worthy of the name.

Oozing properly so-called is the bleeding from numerous vessels too small to be twisted or ligated. This occasionally

occurs from the muscular, cicatricial or other tissue in the wound after the removal of the tonsil. This can be immediately stopped by the insertion of a gauze sponge, which will be held in place by the pillars. If there be not a large enough cavity for the retention of a sponge the size of a walnut, it may nine times out of ten be truthfully said that a complete tonsillectomy has not been done.

The best instrument for removal of the tonsil is largely a matter of personal custom. The author has always maintained that the tonsillotome was an unjustifiable instrument,

FIG. 1.



Author's tonsil scissors.

because it sliced off the projecting portion of the tonsil leaving the submerged portion to be sealed over with cicatricial tissue. He has found recently, however, that the fault is not with the tonsillotome, but with the tonsillotomist. Dr. George L. Richards has demonstrated that it is possible to do a tonsillectomy with a tonsillotome. He frees the tonsil with his finger until it is possible to pull the tonsil out so that a pedicle is formed. Then he severs the pedicle with a tonsillotome from which the fork has been removed. A forceps is used to pull out the tonsil, the ring of the tonsillotome being first threaded over the

forceps, from the shank of which the tonsillotome dangles while the tonsil is being seized. If the same care in freeing the tonsil and pulling it out to a pedicle be taken, the snare might be used, and the author has often so used it. But the objection to the snare is the same as to ice and other hemostatics, that while it lessens hemorrhage at the time, it is more

FIG. 2.



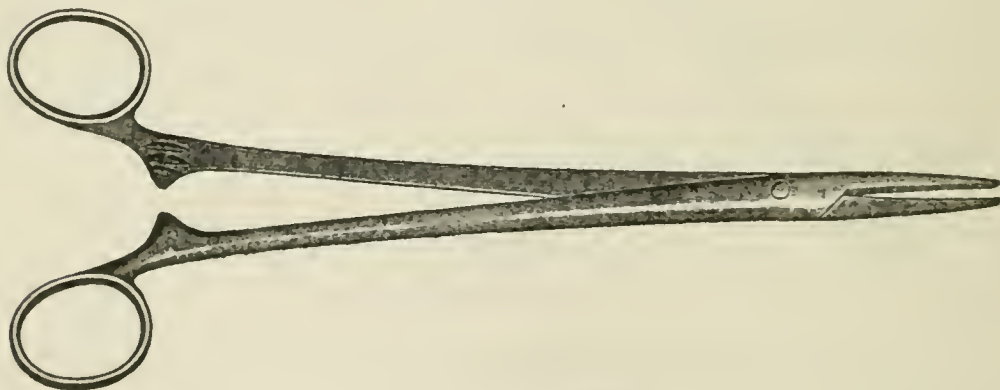
Author's anterior pillar retractor.

apt to be followed by secondary hemorrhage. It is far better to make a clean cut which will bleed freely, and let the operator see the large vessels that he may apply torsion.

Ballenger does a beautiful operation with a knife.

The author's preference is for the scissors, and he uses the scissors shown in Fig. 1. He pulls out the top of the tonsil with a Sandels' forceps, and at the first clip gets external to

FIG. 3.



Author's tonsillar hemostat.

the capsule which is then rapidly ripped away from the tonsillar bed entire and attached to the tonsil, using the blunt end of closed scissors blades as a dissector. Occasionally old cicatrices from peritonsillar abscesses will require clipping.

The anterior pillar is then lifted with a retractor (Fig. 2) while the hemostat serves as a tongue depressor, if one is needed, and the bleeding vessels are immediately found and twisted with the hemostat (Fig. 3) while they are readily seen

by the free flow of blood from their open mouths immediately following their severance. It is to urge this surgical hemostasis at operation, and to point out the error of using ice and other hemostatics to stop bleeding which, if thus stopped, is prone to recur subsequently, that this paper is written. As elsewhere urged by the author (*N. Y. Med. Jour.*, Aug. 17, '07) when the bleeding cannot be arrested, or having stopped, is likely to recur and be fatal, external carotid ligation should be done at once. It is a simple operation of ten or twenty minutes' duration: it may be done under infiltration anesthesia and it is practically without ulterior unfavorable results.

CONCLUSIONS.

1. Tonsillotomy is an unjustifiable operation.
2. Tonsillectomy is less likely to be followed by hemorrhage than is tonsillotomy.
3. Oozing after tonsillectomy is exceedingly rare. It is bleeding from a vessel concealed back of the anterior pillar that is usually mistaken for oozing.
4. The use of ice to the neck and face, or locally over the wound and other hemostatics, are unsurgical and are liable to be followed by secondary hemorrhage.
5. A gauze sponge pushed into the cavity left by the removal of the tonsil will stop slight bleeding, but should never be used when the bleeding is from a vessel large enough to be twisted. If there is not a sufficient cavity to permit the retention of a gauze sponge the size of a walnut by the anterior and posterior pillars, the tonsil is not all out, and the operation is incomplete.
6. Hemostasis with hemostats, promptly done while the vessels are plainly visible by their bleeding immediately after they are severed, promptly arrests hemorrhage and the torsion forestalls secondary hemorrhage.
7. Any hemorrhage not controllable by torsion can be and should be immediately stopped by rendering the whole area anemic by the ligation of the external carotid artery.
8. An anterior pillar retractor and a few long hemostats are an absolute essential to every tonsillectomy armamentarium.

LINGUAL GOITRE.

BY R. A. STIRLING, M.D.,

OF MELBOURNE, AUSTRALIA,
Surgeon to the Melbourne Hospital.

IN the *Lancet* December 8, 1906, Mr. G. H. Makins relates a case of lingual goitre, and states that in the various collations of published cases, not more than between thirty and forty instances have been recorded.

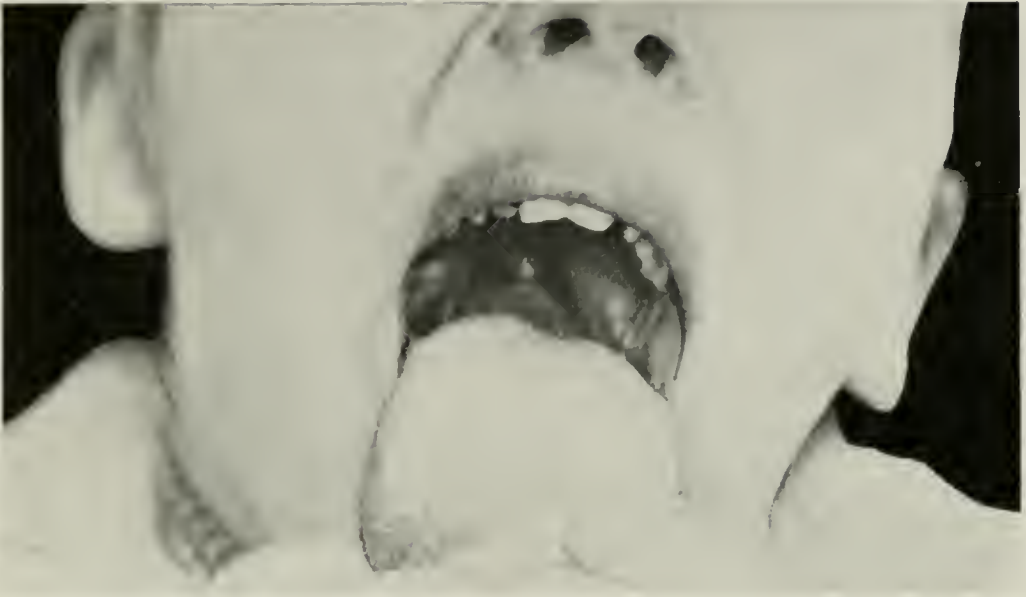
It is very remarkable that soon after reading the excellent description of the tumor in his case, an almost precisely similar one was referred to me by Mr. Phillpots, one of the dental surgeons at the Melbourne Dental Hospital.

The patient, Vena L., aged twelve, was a bright, healthy looking girl. She states that two years ago she complained to the family medical attendant of sore throat—when he called her attention to a swelling at the back of the tongue. This had never been noticed before, but she has found since, especially latterly that there was increasing difficulty in swallowing and speech. There has never been any bleeding from the tumor. She has always been healthy and has not yet menstruated. She complains of thickness of speech, and thinks that the tumor has increased in size recently, and there is always some difficulty in breathing whenever she catches cold.

She was in a hospital some months ago, where it was proposed to remove the tumor, but her father demurred at the possibility of the tongue being divided in the centre.

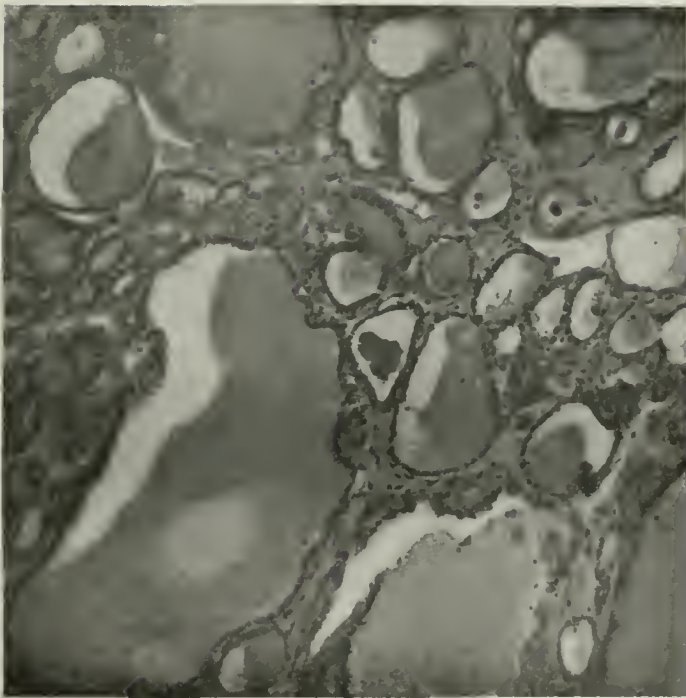
On inspection of the mouth, there is a rounded swelling, about the size of a very large marble, placed on the centre of the base of the tongue (Fig. 1), projecting upwards between the fauces, and apparently springing from the region of the foramen cæcum; the tumor is pinkish in color, covered with mucous membrane showing a very vascular network, and extends down towards the epiglottis for an inch and a quarter—but the laryngoscope shows it is not attached to the epiglottis. Palpation proved that the tumor was not exactly in the midline; that it

FIG. 1.



Lingual Goitre.

FIG. 2.



Microscopic section of lingual thyroid.

extended more to the right than to the left, semi-elastic in consistence, and not giving one the impression of a cystic condition, but rather of a functioning glandular mass.

I could not be certain that the lateral lobes of the thyroid were present in the neck—but at the operation there was no trace of an isthmus.

The diagnosis lay between a lingual goitre and a dermoid cyst. A chronically inflamed lingual tonsil could be ruled out—as it is an affection belonging to the middle period of life, is always associated with pharyngeal dysesthesia, and instead of the circumscribed smooth surface of this tumor, nodular elevations exhibiting a well-marked umbilication are found.

Storrs states that a dermoid cyst in this position is generally yellow, grows rapidly, pits on pressure, and has not the vascularity of goitre.

Operation, May 14, 1907.

Dr. Grubley gave the anæsthetic—chloroform at first on a mask, and then through a tracheotomy tube. Dr. H. B. Devine, my house surgeon, assisted.

On account of the great vascularity of the growth, and of the difficulty of working in so confined a field, it was thought advisable to do a preliminary tracheotomy, especially so in the event of the tumor proving to be her only supply of normal thyroid tissue, Christiana's method of thyroid grafting as quoted by Lannelougue would have been compulsory, or else implantation of thyroid tissue into that of the spleen.

The mouth was gagged, the tongue well drawn out with silk thread, and the pharynx plugged with a sponge. The mucous membrane at the base of the tumor was much hypertrophied and was freely incised. The growth was now enucleated by means of the finger and scissors; a small bridge of tissue at the base being left.

The bleeding was extremely free, but was controlled by sponge (on holder) pressure against the base of the tongue until three deep silk sutures could be inserted—a rather difficult manœuvre in such a position.

The tracheotomy tube was now withdrawn, two catgut sutures closing the opening in the trachea completely.

It was found that a small thyroid was present in the normal position. A few superficial sutures completed the operation. For

four days the pulse rate varied from 140 to 120; but since then it has remained the same as before the operation, and on the fifth day she was up and about the ward—and discharged on the eighth day. So far (June 25th) she has remained perfectly well.

Report by Dr. R. J. Bull on the microscopical examination of the goitre.

The tumor was roughly bilobed, rounded, of about the size of a walnut, and of firm elastic consistence. Microscopically it consisted of more or less typical glandular thyroid tissue divided into lobules by a delicate lowly-cellular fibrous matrix in which blood-vessels and lymphatics were a prominent feature (Fig. 2). The colloidal material was confined to the acini which were lined throughout by cuboid epithelium. As a result probably of imperfect absorption many of the glandular spaces were markedly cystic, the specimen resembling in this respect one of the types of goitre (cystic colloid). In addition to colloid matter many of the larger spaces particularly contained extravasated blood.

The operative procedure can be shortly summed up, thus—shell it out as you would an enlarged prostate and then stop the bleeding.

From the literature at my disposal it would seem that Wolf in 1882 at the German Surgical Congress first drew attention to the real nature of these tumors.

Chamisso collected about 18 examples. Others have been recorded by Benjamins, Watson, Leweles.

Seldowitsch saw a myxedema develop after the extirpation of an accessory thyroid tumor at the base of the tongue.

Collins Warren described in the *Journal of the A. M. A.* a case of goitre at the base of the tongue in a woman fifty-two years of age.

Bernays of St. Louis reports a case where the bulk of the tumor was in the substance of the organ.

Butlin records two similar cases in the *Clinical Society's Transactions*, vol. xxiii, p. 118. Schadle, *Journal A. M. A.*, 1899, August 12, removed one from the tongue of a woman aged 25.

REPORT OF A CASE OF SARCOMA OF THE THYROID.

BY EDGAR A. VANDERVEER, M.D.,

OF ALBANY, N. Y.,

Attending Surgeon to the Albany Hospital.

SARCOMA of the thyroid is of such comparatively rare occurrence that the report of the following case, occurring during my surgical service at the Albany Hospital, seems worthy of being placed on record.

The history of the case is that of M. H., aged 70, white, male, born in United States, married, drayman by occupation. He entered hospital complaining of a tumor on the right side of the neck.

Family History.—Father died of pulmonary tuberculosis; mother died of pneumonia; three brothers alive and well. No history of growths of any kind in any of the relatives.

Past History.—Had the ordinary diseases of childhood; had a fever when he was a young man, which lasted two months. Heart, lungs, kidneys, bladder and stomach negative as to history. Appetite good.

Present Illness.—About six years ago noticed a growth in the neck; it began on the right side and appeared to be loose beneath the skin. This gradually grew until it reached around in front, at the same time gradually interfering with the breathing and the voice. It remained quite loose and movable up to the present time.

The size of the tumor may be judged by the accompanying photographs. It had the appearance of a good-sized cocoanut.

After a careful examination of the tumor, a diagnosis of a cyst of the right lobe of the thyroid was made, and operation advised and accepted.

The description of the operation is as follows:

Upon examination patient presents an enlargement of the right side of the neck the size of two large oranges, symmetrical throughout and fairly movable. There is no pain, but some

dyspnea and difficulty in breathing are experienced (see picture), Injection of a 1 per cent. Novocain solution was made along the most prominent part of the tumor for a distance of some seven inches, in a curvilinear manner, from the mastoid to the mid-line of the neck at the sterno-clavicular junction. An incision was made following this line of injection, and superficial muscles were found very much thinned. On the anterior portion of the tumor were nodules seemingly aneurismal in character, from the external appearance. Incision of one of these nodules gave a large amount of hemorrhage. There were many adhesions enclosing the mass, and much severe hemorrhage from the breaking up of the same. The last portion of the tumor to be removed was deep down behind the right clavicle at its inner third. During the operation traction upon the mass gave severe dyspnea. By reason of the depth of this mass at this point it was deemed dangerous to clamp off the many bleeding points at such a depth, so gauze packing was utilized, as well as one gauze strip in the upper angle of the wound. The wound was then closed with chromicized catgut, and the usual dry dressing applied. At one stage of the operation it became necessary to give chloroform and oxygen for a few moments because of the pain experienced in pulling up on the tumor. Further than this the whole operation was performed satisfactorily under local anæsthesia.

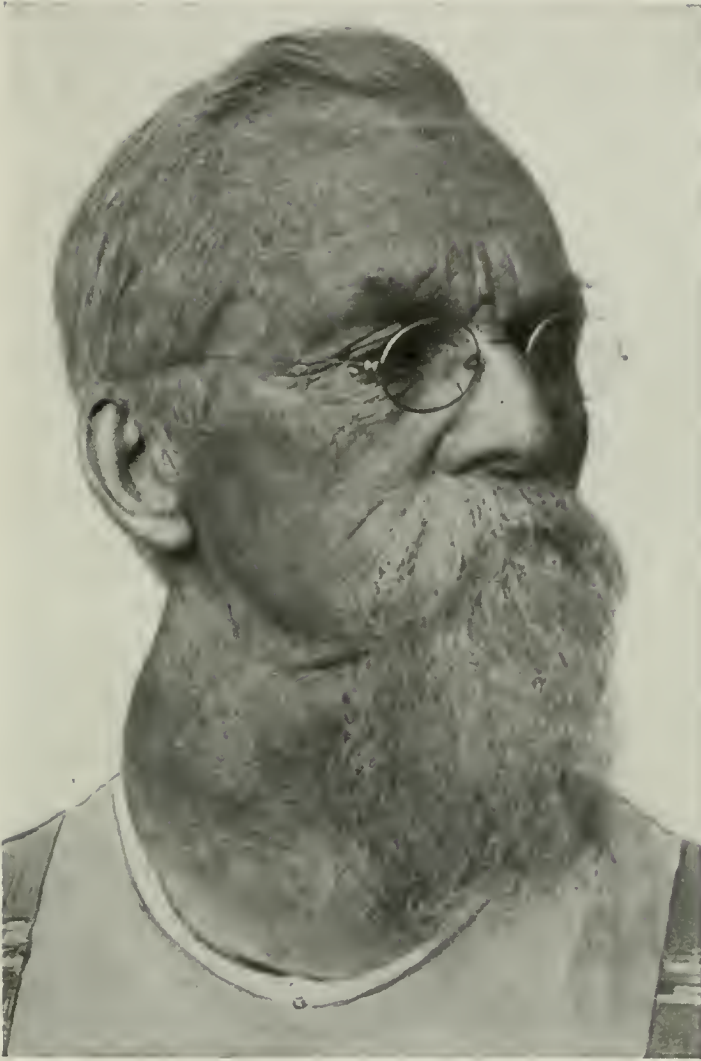
Patient rallied well from the operation, the temperature at no time going above 101° . The second day after the operation the pulse reached 120° , but that gradually reached normal, and the patient was allowed to leave the hospital at the end of twenty-one days, with the wound thoroughly healed, breathing excellent and voice firm and vigorous.

The report from the Laboratory was that of fibro sarcoma of the thyroid gland.

The literature on the subject of growths of the thyroid is fairly abundant, but at no time have I been able to obtain a satisfactory article on sarcoma of this gland.

For a man of his age he stood the operation remarkably well. When we consider that he was seventy years old, and had been a man exposed to the elements more or less all his life, and that this tumor was of six years' duration, a speedy recovery from the shock seems remarkable.

FIG. 1.



Sarcoma of thyroid. Front view.

FIG. 2.



Sarcoma of thyroid. Lateral view.

FIG. 3.



Sarcoma of thyroid ; appearance of neck after excision of the growth.

FIG. 4.



Sarcoma of thyroid; gross appearance of tumor after removal.

NARATH'S MODIFICATION OF TALMA'S OPERATION FOR HEPATIC CIRRHOSIS.

BY EUGENE R. CORSON, M.D.,

OF SAVANNAH, GA.

NARATH's modification of the Talma operation has not attracted any attention in this country;¹ whether it has been taken up in Germany or not I am also unable to say. Narath's original paper I have not been able to get.² It was first brought to my notice by a short excerpt in the *Medical Record* which reported the results in 11 or 12 cases with a brief description of the operation itself. According to this report the operation was very simple, done under local anæsthesia, and followed by remarkably good results. Through a small incision in the mid line below the ensiform cartilage the peritoneum is opened, a bunch of omentum is picked up, drawn out, and tucked under the skin, and stitched in place with a few catgut stitches. The incision in the abdomen is carefully sewed around the base of the omental mass, sufficient to close the abdomen, yet avoiding any constriction of the omental tissue itself. The abdomen is carefully closed in layers as is now the custom. The operator, as he sees fit, may do a one-sided operation, or he may pick up a second bunch of the omentum and stitch it in on the opposite side, should he think it necessary to increase the area of transplantation. According to Narath, the subcutaneous veins become prominent in a week, and the relief to the obstructed portal circulation is at once apparent. He reports no case of hernia, and writes enthusiastically of his method.

There are two points in this operation which impressed

¹ The only allusion to it I have seen, occurred at a discussion on the Talma operation at the New York Academy of Medicine, Nov. 16, 1905, when Dr. Franz J. A. Torec reported a successful case which was practically Narath's operation.

² *Über subcutane Verlagerung des Omentum*, Zentralbl. f. Chir. No. 32.

me favorably, namely, its simplicity, and most important of all, the direct implantation of the omentum subcutaneously, for nature seems best able to perfect a collateral circulation through the superficial veins.

It is only within recent years, comparatively speaking, that anatomists have worked out thoroughly the relationship, the sites of anastomosis, between the portal and systemic circulation. As bearing so vitally upon the problem before us let me briefly summarize the results of modern research on this anatomical point. In a paper by Dr. Rolfe Floyd in the *Medical Record* for July 4, 1903, entitled "The Anatomy of Portal Anastomosis," the whole subject has been most admirably set forth and I shall quote largely from it and reproduce two of his instructive diagrams. There are several points of interest in Dr. Floyd's paper bearing on the subject. He writes: "I have found no record of a case of failure of complete closure of the ductus venosus with a secondary enlargement of this vessel in portal obstruction, and so far as I know, this vessel never supplies a channel of portal anastomosis in the adult." It would be interesting to know if any cases have been reported of the non-obliteration of the ductus venosus. Nature has evidently safeguarded this structure with unusual care, as she does not prove so careful with some other foetal organs. Again, according to our author, there has been some dispute as to the complete obliteration of the umbilical vein. "Sappey, '83, stated that all cases reported as patent umbilical veins, secondarily enlarged and furnishing an anastomotic channel in portal obstruction, were, in truth, not such, but enlarged veins running parallel with the round ligaments, and that the latter structure could always be demonstrated in such cases, in its usual adult condition. Baumgarten, '77, however, had stated that with the microscope he had found a minute central venous canal in the round ligament in fifty-four cases out of sixty, and that this canal became dilated in portal obstruction. Wertheimer, '86, looking into the matter somewhat more deeply, found that the narrowed lumen of the vein was completely occluded shortly after birth by a plug of connective tissue, and

that subsequently, within a year or two, in the majority of his cases, nine out of sixteen, a venule appeared in this central plug which communicated with the small veins coursing on the surface of the round ligament. This central venule penetrated the round ligament from its attachment to the abdominal wall to its junction with the still patent region within the liver. This venule was occasionally double, or broken into a fine, venous net. At the same time he reported three cases of portal obstruction, in one of which the round ligament was not enlarged, and contained no central venule, while in the other two there was a distinct enlargement of the round ligament as a whole, and an increase of the central channel to eight times its usual diameter."

"Thus it appears that in some cases, at least, the umbilical vein may be reclaimed, in this roundabout fashion, to its function as a blood vessel, and form a channel of communication between the portal and systemic veins."

Dr. Floyd mentions four normal sites of anastomosis between the portal and systemic veins in the adult.³

"1. Anastomosis at the lower end of the œsophagus. The coronary vein of the stomach receives radicles from the lower end of the œsophagus, which lie chiefly between the mucous and muscular layers of its wall. The same region is also drained by veins which pass to the phrenic veins, and so to the inferior cava, and by veins which unite to form the inferior œsophageal tributaries of the azygos veins and so enter the superior cava (Fig. 1.1). In the body which I dissected in connection with this paper, the two most evident veins in this region were the coronary vein, and a lower œsophageal vein which passed to the vena azygos major.

"2. Rectal anastomosis. The hemorrhoidal venous plexus lies between the muscular and mucous coats of the rectum. It is drained above by tributaries of the inferior mesenteric vein of the portal system, laterally, by rectal veins which enter the internal iliacs and, below, by the inferior hemorrhoidal veins which pass to the internal pudic veins, and so again to the

³ Gray gives practically the same sites of anastomosis.

internal iliacs (Fig. 1.2). This plexus thus constitutes a pretty free anastomosis between the portal and systemic veins. In the

FIG. 1.

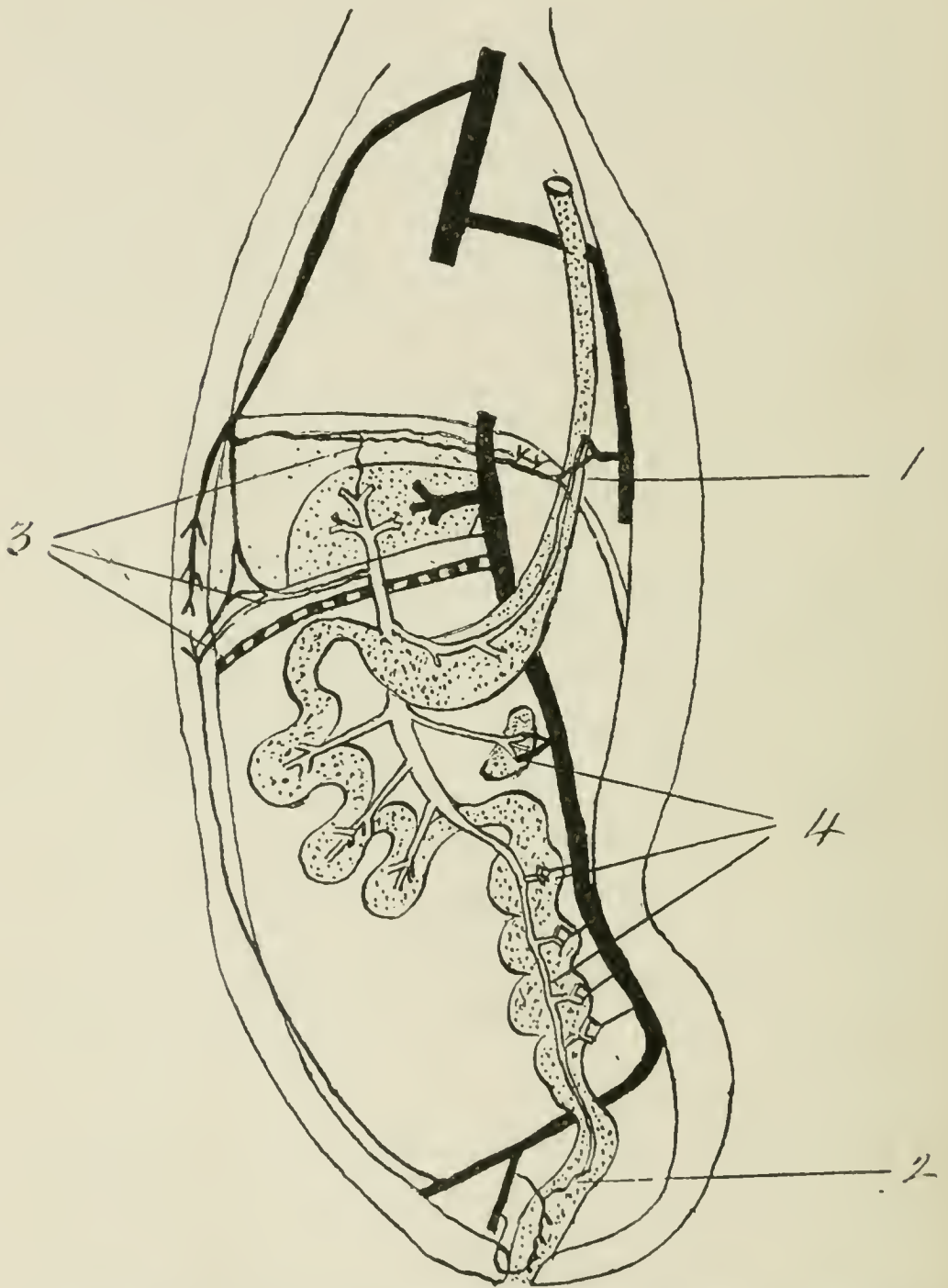


Diagram to show the sites of portal anastomosis in the adult; the portal system of veins is shown in outline, the systemic veins in black, the round ligament and ductus venosus in broken line; the viscera are indicated by thick dotting, the suspensory ligament by sparse dotting (Copied from Rolfe Floyd, *Medical Record*, July 4th, 1903).

body which I examined injection mass, thrown into the internal iliac, passed into the inferior mesenteric vein, establishing the fact of the anastomosis in that case beyond question.

“3. The accessory portal veins of Sappey. These are veins in the suspensory ligament of the liver, which establish anastomosis between the portal system on the one hand and the veins of the anterior abdominal wall and of the diaphragm on the other (Fig. 1.3). Those which pass up to the phrenic veins take origin within the liver substance from small portal branches, not from the portal trunk, and emerge from the upper surface of the organ to enter the suspensory ligament. Those which pass forward, on the other hand, root in the portal vein in the transverse fissure. Some of these course along the surface of the round ligament, while others lie higher up in the suspensory ligament. These veins regularly connect with the veins of the anterior abdominal wall. The situation of one of these veins in the centre of the round ligament has already been referred to. In the body which I examined they united, while still in the suspensory ligament, with vessels derived from the internal mammary and deep epigastric veins.

“4. The retroperitoneal veins. The duodenum, the pancreas, and part of the colon lie immediately against the posterior abdominal parietes, and, just as in any other continuous mass of tissue in the body, the veins of these viscera, belonging to the portal system, become more or less continuous with the systemic veins of the parietes (Fig. 1.4).”

These four sites are shown in Fig. 1. In the second figure I copy from Dr. Floyd's paper are shown the chief veins of the anterior abdominal wall which are of interest to us in the collateral circulation of portal obstruction. He enumerates the following branches: (1) Deep epigastrics, tributaries of the external iliac; (2) superficial epigastrics, tributaries of the femorals through the saphenous; (3) superior epigastrics, tributaries of the internal mammaries; (4) intercostal veins of the sixth to the ninth spaces, tributaries of the azygos veins.

These valuable researches of Dr. Floyd point to the accessory portal veins of Sappey, uniting freely as they do with the

anterior abdominal veins, as the chief site where nature is enabled to form a collateral circulation. Again, they seem to show that these accessory portal veins which pass forward should be more efficient for the new channel than those which pass up to the phrenic veins, as the former "root in the portal

FIG. 2.

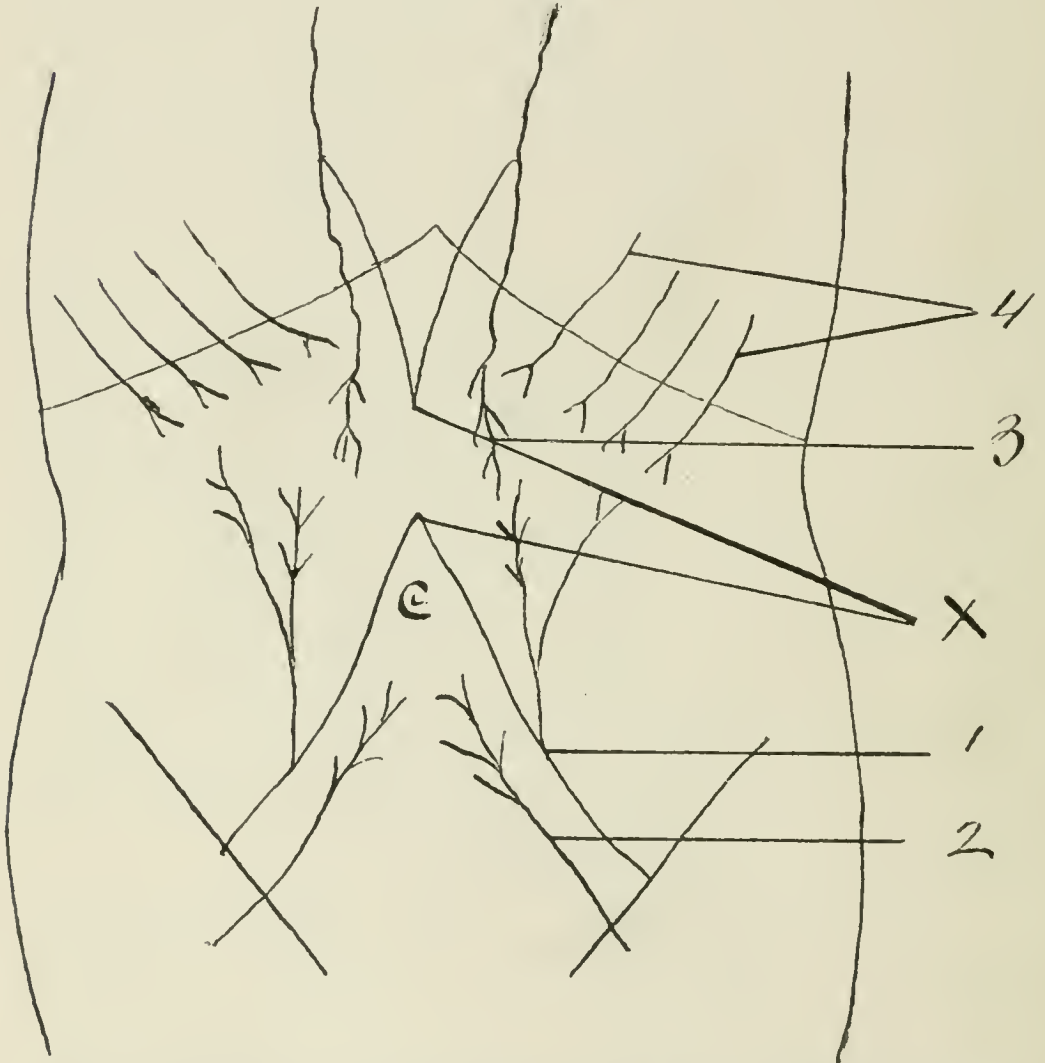


Diagram of the veins of the anterior abdominal wall; 1, deep epigastric; 2, superficial epigastric; 3, superior epigastric; 4, intercostal; X, branches from the internal mammary and deep epigastric veins which pass into the suspensory ligament (Copied from Rolfe Floyd, *Medical Record*, July 4th, 1903).

vein in the transverse fissure," while the latter "take origin from within the liver substance from small portal branches, not from the portal trunk." Therefore, uniting the superior surface of the liver to the opposing surface of the diaphragm, as

is done in the Talma operation, is not so efficient as uniting the omentum to the anterior abdominal wall, either by stitching it to the peritoneum, or preferably, as I believe, by its subcutaneous insertion, as in the Narath operation. In this way, by bringing the portal vessels of the omentum in direct contact with the tissues in which these superficial abdominal veins lie, a more direct collateral circulation is established. That there should be an evident enlargement of the superficial abdominal veins in a week after the operation shows how quickly nature has availed herself of this new channel.

To show nature's wonderful resources in the way of a collateral circulation by the superficial abdominal veins, we can find no more signal example than in the case of obliteration of the superior vena cava, so minutely described by Professor Osler in the *Bulletin of the Johns Hopkins Hospital* for July 1903. The paper is well worth reading in connection with our present subject. In this case nature was enabled to carry the venous blood from both arms and the head back to the heart through the superficial veins of the chest and abdomen, reaching the right auricle by the azygos and the inferior vena cava.

While I have but one case of Narath's operation to report the signal success I obtained under the most adverse conditions prompts me to publish it in the hope that the operation may have the extended trial I think it deserves. I first saw the patient in question in the fall of 1904 and operated in January, 1905, and as he writes me of continued improvement up to the present time, eighteen months after the operation, I feel that a sufficient length of time has elapsed to show the value of the procedure.

G. M., white, single, *aet.* 43, shows a good family history. He had a severe typhoid fever when 22 years old which nearly resulted in his death. When 36 years of age in Cuba, in the Spanish-American war, he had dysentery, malaria, yellow fever, and ascites. Under the treatment of the army surgeon he apparently recovered. The ascites did not return till June, 1904. Patient has had gonorrhœa several times; he has used intoxicating

liquors in moderation up to the time he went to Cuba when he used them to great excess. In September, 1904, he had a Hunterian sore, followed in six weeks by pronounced secondaries: all the typical symptoms, roseola, a papular syphilid, sore throat, fever, bone pains, and alopecia. I saw the patient first early in October before the secondaries appeared. He had pronounced ascites at the time; his face had the characteristic drawn expression of abdominal distension; he was thin and somewhat jaundiced; the urine showed a trace of albumin; altogether he presented a clinical picture well nigh hopeless. I ordered him into the hospital. I lost sight of him till December when he was brought to my notice in the ward, with some secondaries still out on him, and under full specific treatment. On December 29th he was tapped by the house-physician who removed two gallons of fluid. This rapidly re-accumulated. I operated first on January 4th, under general anæsthesia. I made a median incision about four inches long below the ensiform cartilage and let out nearly two gallons of fluid. Palpating the surfaces of the liver I made out a cirrhosis in its most advanced stage. Without exaggerating I can only liken the sensation to the examining hand of a bag full of marbles, so pronounced was the bosselation, if I may coin a word. The gall bladder seemed normal. I tucked a bunch of omentum under the skin on the right side, spreading it out as much as possible. I carefully sewed around the base of the omental mass and closed the abdomen in layers. There was no reaction from the operation. At the end of a week there was a distinct increase in the size of the abdominal veins, as described by Narath. The abdomen, however, filled up rapidly again, and on January 30th I repeated the operation, letting out an amount of fluid quite equal to the previous tapping. This time I tucked a bunch of omentum under the skin on the left side just below the first omental graft and closing the abdomen as before.

After this second operation the patient almost immediately expressed himself as feeling better. Though there was an evident re-accumulation of fluid, it was neither so rapid nor so extensive. He was up and about walking in the hospital grounds. An improvement was evident to all who were watching the case. He was not tapped again. He shortly left for the National Soldiers' Home in Tennessee where he was offered a home, and he has

remained there ever since. He has regularly written me short accounts of himself, all indicating a gradual improvement.

In a letter dated July 8, 1907, he writes: "My abdomen is still swollen some, but the surgeon here says it is from gas, and there is no water or very little in the stomach. My strength has improved a great deal in the last three or four months, and I sometimes take walks of two or three miles distance. After exercising a good deal during the day my ankles swell a little, but go down again before morning. My appetite is very good, although my food consists mostly of milk and toast, as this seems to agree with me best. I sleep extra well, except I dream a good deal.⁴ Where the incisions were made by the operation I suppose I am ruptured there, as they extend out about two inches when I am not using a bandage; I wear this bandage all the time. The veins on my stomach are very prominent, and I am short of breath when going up grade. The greatest trouble I have is in trying to climb upon something about three or four feet high, as a box. My bowels do not act regularly and I have to take a good deal of purgative medicine every day or two. When I press upon the outside of the incisions on my abdomen it feels sore inside. . . . My weight is 151 pounds."

Considering the condition this man was in at the time of operation, and complicated, too, by syphilis in its secondary stage, the result obtained by this operation seems to me remarkable. In the few cases I have seen reported of successful Talma operations the patients have undergone repeated tapplings until the collateral circulation was equal to the emergency. In this case the collateral circulation seemed to have been established quite rapidly. Whether there is a real hernia in addition to this double epiplocele I, of course, cannot say without examining my patient. Before he left the hospital the epiplocele was very evident on inspection, probably rising a half inch above the skin. It is possible that the enlargement in the omental vessels may be sufficient to account for the increase in the protuberance.

The success attained in this advanced case would point to

⁴Is this the result of the brain getting portal blood which has not been cleared by passage through the liver?

a much greater success for the operation if done in the beginning of the cirrhotic process. It would be interesting to know if there has been any improvement in the condition of the liver, a reduction in the fibrosis. I am inclined to think that nature has accomplished something in this direction. We do see it in other forms of fibrous proliferation.

The Talma operation has a considerable mortality, never less in all cases than 10 per cent., and where the cirrhosis is advanced this mortality is greater. I think it is a mistake to leave any open drainage for the ascitic fluid, as infection is bound to occur sooner or later. The mortality of Narath's operation must be little or nothing. As the majority of these cases do not get to the surgeon before the disease has reached an advanced stage and any serious operation is very risky, the simpler operation of Narath's offers the best chance for help, even with the inconvenience of an epiplocele and a possible hernia. The chances of this latter complication do not seem to be great. The position of the epiplocele is not favorable for hernia, and the transplanted omentum must act as a plug against the protrusion of the gut.

ACUTE PANCREATITIS.

WITH REPORT OF TWO CASES.

BY WALTER A. JAYNE, M.D.,

OF DENVER, COLORADO,

Professor of Gynecology and Abdominal Surgery, Medical Department, University of Denver.

It was in 1889 that Dr. Reginald Fitz published his monograph on acute pancreatitis, and forcibly calling the attention of the medical profession to its various forms, gave that masterful description which has since been the classic to which we turn when we study this disease. He told us at that time that it occurred more frequently than was generally thought, and ten years later Mr. Mayo Robson made the same statement as the result of his large surgical experience. Time has proven that these assertions were amply justified. In recent years pancreatitis has excited an increasing interest. Many articles of the greatest value appearing in our medical journals have made us more familiar with its manifestations, and the more frequent reports of cases observed and treated surgically suggest that instead of being overlooked it is coming to be more commonly recognized.

The location of the pancreas is obscure and the difficulties of diagnosis from the symptoms alone are so great that the presence of pancreatitis is seldom determined in advance of operation or a demonstration at the dead house table. The violent, acute forms are not so common as to force themselves upon the watchfulness of the general practitioner. We must believe that milder forms occur with considerable frequency, and subsiding without notable incident, or followed, possibly, by a moderate and late induration, the true nature of the attack escapes recognition and is ascribed, most plausibly, to acute indigestion, gall-stone colic, or if prolonged, to "gastritis."

We know that the pancreas is one of the most important organs concerned in digestion, and that the large proportion of our food is dependent upon the chemical action of its secre-

tions for preparation for successful assimilation and the proper nutrition of our bodies. Physiologists tell us that normally the pancreas produces certain enzymes,—the amylolyptic, the lipolyptic and the proteolyptic,—each varying in amount, responding to demand, and adapted to the breaking up of the class of food indicated by the name, and, that it controls the carbohydrate metabolism, whether directly by some internal secretion or otherwise is not yet clear.

Since the secretions of the pancreas take so prominent a part in the chemistry of digestion, it has been confidently expected that the excretions, upon careful analysis, would yield positive evidences of the interference with or interruption of its functions, we have assumed to be incident to disease, whether acute or chronic, and give definite guides to diagnosis. Notwithstanding diligent search such evidences have yet proved so elusive, inconstant and uncertain as to afford us no sure guide when most urgently needed, and we have helpful suggestions only, occasionally present in the later stages of acute disease, more frequently in the chronic and malignant forms. In acute pancreatitis, therefore, and too often in chronic induration, cystic and cancerous disease of the pancreas we must still depend upon the clinical manifestations at the bedside for our diagnosis, unless indeed an exploratory incision gives us the demonstration. We should be watchful, however, for such chemical or microscopical evidences as may occasionally occur. If we may assume that the pancreas is incapacitated for all function at once upon the onset of an acute inflammation, the explanation of the absence of corresponding indications in the excretions may be found in the fact that the contents of the stomach are promptly ejected, and no food is taken for some days at best, not until, by happy chance, convalescence is in some degree established. A further reason may be, as Fitz has stated, that "the functions of the pancreas are not the exclusive property of this gland, but are possessed to a greater or less extent by other structures and other agencies," and the evidences are obscured.

During the past ten years surgery has extended its field

of activity to the upper abdominal cavity, and the opportunity thus afforded to study the diseases of this region in place, instead of in the dead house only, has assisted in shedding valuable light on the ever varying symptom complex these diseases present for our analysis, and has materially advanced our diagnostic ability. This experience has demonstrated that diseases of the pancreas are neither so very rare or necessarily unrecognizable, and that with better acquaintance acute pancreatitis may often be determined without exploratory incision.

The subject is not fully understood, and the diagnostic indications are seldom clear. Many problems, theoretical and practical, remain to be solved, and each case observed is therefore of especial interest. With the hope of aiding in the further elucidation of acute pancreatitis I beg to report two cases which happen to have come under my care during the past year.

CASE I. Mrs. —, aged 33, of good physique, weight 135 pounds, had never had any illness of moment. Previous health excellent except that for two months prior to her present illness she had had slight "intestinal indigestion," characterized by epigastric discomfort and distention after eating, for which she had been under treatment. August 22nd, feeling particularly well on rising, she was seized with a sharp, smarting, agonizing pain at the epigastrium as she was entering her bath, prostrating her to the floor, and followed shortly by nausea and vomiting. Dr. H. W. Hoagland, of Colorado Springs, saw her about an hour later. She was suffering severely, face bluish, pulse 82, temperature normal, no shock, abdomen tender and slightly tympanitic. The pain was temporarily relieved by morphia with atropia, but later returned, being dull and persistent, accompanied by nausea and vomiting. Evening pulse 84, temperature 99.5. The next day, pulse 76, temperature normal, expression good. The third day, morning pulse 100, temperature 99.6. The nausea and vomiting had persisted, and notwithstanding repeated cathartics and enemata the bowels had not moved. During the afternoon she became worse, pulse 120, temperature 100, abdomen greatly distended, tympanitic and tender.

With Dr. Hoagland I saw her sixty-three hours after the

attack. The face was grayish, expression anxious, tongue coated, pulse 130, temperature 100.5, abdomen large, tympanitic and very sensitive, especially at the epigastrium and extending to the left hypochondrium, with resistance and suspicion of a deep-seated mass. The diagnosis lay between acute obstruction of the bowels from unknown cause, acute pancreatitis, and perforating ulcer of the stomach or duodenum. The known previous history did not suggest ulcer and perforation was therefore considered improbable. The condition was grave, peritonitis impending if not already present, and immediate exploratory incision was decided upon. While preparations for operation were being made the bowels moved voluntarily and copiously and again an hour later after enema. The discharge was liquid, ashen gray, offensive, and to the naked eye contained no fat or undigested food. The patient was so greatly relieved that operation was not advisable. The nature of the attack was left in question, but as acute pancreatitis remained as the only probable and sufficient explanation she was watched for confirmation of this tentative diagnosis.

Although relieved of urgent symptoms the patient was left exhausted, lethargic, and confined to bed with an undefined discomfort at the epigastrium, tongue furred and disinclination for all food. For ten days her condition remained about stationary, pulse from 96 to 120, temperature normal or subnormal, abdomen large, tympanitic, sensitive, resistant and palpation unsatisfactory but with increasing suspicion of a mass. From the eleventh to the sixteenth day the evening temperature ran from 99 to 99.4. On the thirteenth day an embryo of one month was discharged. From the sixteenth to the nineteenth day the evening temperature varied from 100.4 to 101. The abdomen was softer and though still distended an epigastric mass could be distinctly felt. Deep-seated, it appeared to be about the size of a flattened orange. Abruptly terminating an inch to the right of the median line it seemingly extended beneath the ribs on the left, but was separated from the liver by a distinct space. During the next four days the temperature declined each evening until it reached 99.2, pulse averaging 100, and the patient became stronger and brighter, with an improving appetite. On the evening of the twenty-fifth day she was seized with a chill followed by vomiting, pulse 120, temperature 100.4. The next morning the temperature was above 99 for the first time, registering 101.5. Examination showed the

mass to have increased in size. It was pushing to the right and upward to the liver, and was very tender. On the twelfth day a blood count showed a leucocytosis of 11,000; the twenty-second day, 15,000; and on the twenty-seventh day, 30,000, no differential count being made. Examination of urine and feces had been negative, the urine now showed positive reaction for acetone and diacetic acid.

After consultation, in which Drs. Gardiner of Colorado Springs, Isaac Adler of New York, Freeman and Powers of Denver joined, the diagnosis of abscess of the pancreas was concurred in and an exploratory incision was determined upon.

Operation September 19th, four weeks from date of attack, Drs. Freeman and Powers assisting. Incision at the epigastrium, five inches in length, through the right rectus, one inch from its inner border. On opening the abdomen disseminated areas of fat necrosis were found in the omentum. The mass, five inches in diameter, lay behind the stomach, extended about three inches to the right of the median line, approached the liver and was attached to all adjacent structures by adhesions. The gall-bladder and common duct were uncovered, as far as was deemed safe without opening the abscess, but sufficiently to demonstrate their healthy condition and the absence of gall stones. The peritoneal cavity being protected by gauze, the gastro-colic omentum was opened and by blunt dissection, in a direction upward and backward, at the depth of a finger's length a pocket containing about eight ounces of thin, grayish pus was discharged, and further exploration opened two smaller subsidiary pockets in the substance of the gland. The pus cavity having been wiped dry, a large (five-eighths inch) rubber tube protected by gauze was passed to the bottom of the abscess and fixed by suture, packing removed, and the upper two-thirds of the incision closed by layer sutures. But little shock followed and the patient improved from the first, making an uneventful recovery until the sixth week. Dr. W. C. Mitchell reported the pus taken at operation as giving a pure culture of the colon bacillus.

She was placed on the right side to favor drainage which for the first four days was very copious, saturating the large dressings in a few hours, and then became less purulent, diminished in quantity and at the end of a week it had become a free discharge of a thin, clear, watery, alkaline fluid, of sweetish odor, evidently

pure pancreatic juice. Wherever the discharge came in contact with the skin it caused a sharp dermatitis, and the wound became red, swollen and appeared about to suppurate, but on the removal of the sutures on the sixth day complete primary union had taken place. Repeated enemata of a solution of sodium bicarbonate were given for several days following the operation on account of the acetone and diacetic acid in the urine, which finally disappeared on the tenth day. The granulations, seemingly stimulated by the pancreatic juice, rapidly filled the wound which was reduced to a narrow fistulous track, and on the fourteenth day, the discharge no longer containing pus, the tube was removed. The discharge continued free until the night of the twenty-first day after operation when it abruptly ceased and the next morning the wound was permanently closed.

During convalescence the diet, consisting of broths, fowl, meats and toast, was generally well taken care of, occasionally, however, meat fibres appeared in the stools. The strength returned steadily and by the sixth week she was about the house and driving out. Examination showed the scar sound, abdomen soft, no tympanites, no tenderness. Little or no induration at the head of the pancreas could be felt on deep palpation, though the abdominal wall was attached to its location.

After unusual fatigue the previous afternoon, at ten o'clock of the fortieth day following operation, a light breakfast having been taken, she was seized while still in bed with a dull aching and later a smarting pain at the epigastrium, with nausea, increasing in severity during the afternoon and evening. At 4 P.M. the pain was located under the cicatrix and described as of the same character as the original pain. The facies were good, pulse and temperature normal. Through the lax abdominal walls immediately beneath the scar at the location of the head of the pancreas a firm, tender mass, about the size of a small flattened orange could be readily palpated. An enema brought away some feces with undigested food (meat and peas) eaten the previous day. During the evening she vomited, the pain became severe and three hypodermics of codeia and morphia were required for relief. The following day the pain though present was bearable, nausea persisted and large quantities of bile were vomited and the mass was decidedly larger and very sensitive. By evening the pulse was 120, vomiting persistent, and the abdomen was becoming dis-

tended and tympanitic. Repeated enemas had no result until at midnight when the bowels moved freely giving prompt and final relief. The following day she was again convalescent but the enlargement of the head of the pancreas diminished slowly and it was three weeks before it could no longer be felt. Five weeks later she had an attack of epigastric pain of similar character, lasting twenty-four hours but without nausea, and relieved by continuous warm applications. She was not seen by a physician at this time. There have since been no symptoms referable to digestion or the pancreas, and the general health has remained excellent.

CASE II.—Mrs. —, aged 65, never had an illness, robust and in good health, weight 170 pounds. At 10.30 A.M. February 10th, after an unusually hearty breakfast she was seized with vomiting, followed immediately by a sharp pain under the right shoulder blade, passing rapidly to the epigastrium. Dr. H. T. Pershing saw her a few moments later and making a diagnosis of gall stone colic gave a hypodermic of morphia with atropia. The pain was relieved but returned after a few hours, continued during the night, and becoming severe toward morning another hypodermic was given. She was referred to me and at noon the pulse was 90, temperature normal, no pain, nausea, and slight tenderness at the epigastrium. After a restless night she complained of gastric distress, nausea, occasional vomiting, thirst, no pain. Tongue dry, coated, pulse 120 and quick, temperature 100, epigastrium slightly distended, resistant, sensitive to pressure and on deep palpation a small, firm, flattened mass could be felt at the location of the head of the pancreas. The following day the vomiting was persistent, nourishment by mouth was supplemented by salt solution and nutrient enemas. Conjunctival but no cutaneous jaundice. The fifth day she was worse, general restlessness, gastric distress, thirst, nausea and vomiting. Tongue furred and dry, pulse 116, epigastric distention and sensitiveness increased, mass distinctly larger. Urine of yesterday and to-day examined by Dr. W. C. Mitchell who reported: color reddish, specific gravity 1033, acid, no albumen, sugar, pentose, arabinose, indican, Cammidge's crystals (*Surgery, Gynecology and Obstetrics*, September, 1906), or fat splitting ferment (Opie, *Bulletin of J. H. Hospital*, May, 1902), diazo negative, bile pigments positive. Blood count by Dr. J. C. Todd, reds 4,000,000, slight poikilo-

cytosis, leucocytosis 16,800, differential count; lymphocytes 8.8, transitional forms 6, polymorphonuclears 85, eosinophiles 0.2 per cent. On the morning of the seventh day she was seized with a lancinating pain at the margin of the left ribs, interfering with breathing, and of diaphragmatic origin, complained of epigastric fulness and weight which made lying on the back uncomfortable and movement in bed difficult. Tongue coated and dry, nausea but no vomiting, nutrient enemas stopped, pulse at noon 128, temperature 100.4. Epigastrium prominent, resistant and the mass as large as a medium sized grape fruit readily felt and very tender. In consultation Dr. Leonard Freeman concurred in the diagnosis of acute pancreatitis with possible commencing pus formation. Dr. Todd reported on the blood taken at the same time; slight poikilocytosis, leucocytosis 14,500, differential; lymphocytes 16.5, transitional forms 8.2, polymorphonuclears 74.5, eosinophiles 0.8 per cent., a suggested improvement not corresponding to the clinical evidence. Two days later her condition was improved, though gastric weight and discomfort continued, nausea had ceased, pulse 110, mass unchanged. Blood count, slight poikilocytosis, leucocytosis 13,500, differential; lymphocytes 14, transitional forms 6, polymorphonuclears 79, eosinophiles 0.75, mast cells 0.25 per cent. Urine, trace of albumen, few hyaline casts, otherwise negative. Twelfth day, patient improving, taking liquid nourishment well, still complains of weight at epigastrium; abdomen softer, mass firm, less tender, somewhat smaller, pulse 110. Blood count, slight poikilocytosis, leucocytosis 9,500, differential; lymphocytes 17.2, transitional forms 6, polymorphonuclears 76.4, eosinophiles 0.4, mast cells 0.2 per cent. Urine faint trace of albumen, otherwise negative. Examination of feces by naked eye, negative until convalescence, when meat fibres were occasionally found. The temperature throughout varied very little, ranging from 99 to 100.4. It reached 100 on the morning of the third day, and 99.8 to 100.4 on the evenings of the fifth, sixth, seventh and eighth days.

From this time the patient made a slow but uninterrupted recovery. When she passed from observation six weeks after the beginning of the illness she was anæmic, feeble and just able to travel. Digestion good on a diet restricted to fish, meats, fowl, eggs and toast. The head of the pancreas was still easily mapped out by deep palpation as a flat, hard mass, lying deep at epigas-

trium and insensitive except on firm pressure. Recent reports state that in August she had an attack of what was diagnosed as gall stone colic while on her way to Carlsbad, from which she promptly recovered, and that her health is slowly becoming re-established.

While it would appear that these cases are fair examples, the one of acute suppurative pancreatitis the other of acute pancreatitis with resolution, they present several features of unusual interest.

Etiology.—Mr. Mayo Robson attributes acute attacks of pancreatitis to the invasion of bacteria, the infection almost always entering through the ducts (*Lancet*, July 28, 1900). Flexner, Opie and others have shown by animal experimentation that bile, gastric juice and other substances act as irritants when thrown into the pancreatic ducts and produce violent and fatal inflammation of the gland. (Transactions of the Congress of American Physicians and Surgeons, vol. vi.) We know from clinical observations that pancreatitis, both acute and chronic, is often associated with cholelithiasis. Opie has apparently demonstrated at autopsy, following acute pancreatitis in the human subject, that the retrojection of bile had in that case produced the disease, and explaining the mechanism by which it may occur when a gall-stone is lodged in the diverticulum of Vater, urged this as a common cause of this disease. (*Bulletin J. H. Hospital*, 1901, xii, 182.)

After a careful study of the above cases it is believed that we are justified in assuming that they illustrate, as far as may be, both of these theories of causation. Case 1 was preceded by gastro-intestinal derangement, inflammatory or catarrhal, a condition associated with bacterial activity. There had never been, nor was there during the progress of the case, any jaundice, bile pigment in the urine, or other symptom suggestive of cholelithiasis, and although the pancreatic portion of the common duct only was not examined at the operation, the remainder of the bile passages were so absolutely normal, as to fairly negative the assumption of the presence of a gall-stone at the diverticulum of Vater. The pus at operation yielded a pure

culture of the colon bacillus. These facts point sharply to an ascending infection from the duodenum.

In the second case we have positive evidences of disturbance in the bile passages; the primary pain was typical of gall-stone colic; bile pigments in the urine and the jaundice point to a cholangitis; local evidences of pancreatic involvement did not occur until nearly forty-eight hours later; the pancreas though swelling rapidly to large proportions passed to resolution within the week, all suggestive of an inflammation from a violent irritant, quite possibly from the retrojection of bile into the pancreatic ducts as set forth by Opie.

Clinical Course.—The symptoms in the first case are very closely in accord with the classical descriptions. The sudden, sharp, agonizing pain at the epigastrium; shock more or less pronounced; nausea and vomiting; motor insufficiency of the intestines; distention and tympany; threatening peritonitis; rapid pulse with moderate temperature, form a symptom complex by no means characteristic of acute pancreatitis, which may be presented by several other conditions. Careful physical examination unless made before tympany and rigidity occur, is incomplete or unsatisfactory, and a moderate epigastric tumor may easily escape detection, as was probably the case here. The relief obtained when the bowels finally moved was apparently so complete that for several days the expectation of convalescence appeared fully justified. The lethargy, lack of appetite, furred tongue, continued rapid pulse out of proportion to the temperature or apparent condition, epigastric discomfort without pain, made up the clinical picture until the evening rise of temperature created suspicion of sepsis and abscess formation. About this time the subsidence of tympany and resistance permitted the mapping out of the circumscribed mass, which previously had been indistinct, and thereafter its development could be closely followed until the local indications, taken with the pulse, temperature, and blood count, confirmed the original diagnosis and completed the diagnostic picture for those who had had the opportunity to follow the case.

The subacute attack following so closely upon the demonstration at operation left no question as to its nature. The condition of the pancreas is known to have been negative a few days before, yet within six hours after the apparent inception of the attack, the abdominal walls being lax and deep palpation easy, the gland was found to be very considerably enlarged, firm and not particularly sensitive, leaving the impression that the swelling must have commenced some little time previous to the symptoms, or have taken place with surprising rapidity. It is of interest to note the prompt and complete relief following movement of the bowels, and to compare the almost equal relief similarly obtained on the third day of the original attack, the prompt disappearance of the tenderness within a very few hours, and the slow recession of the pancreatic swelling.

The most notable features of the second case, aside from the original pain, were the general anxiety, epigastric discomfort and weight, thirst, persistent nausea, jaundice, a pulse rapid and quick out of proportion to the temperature and the very rapid and considerable enlargement of the pancreas, the changes in which, as in the relapse in the first case, were watched closely at frequent intervals. The blood count was a most valuable diagnostic and prognostic aid. On the seventh day, when all the clinical signs except the temperature seemed to indicate the imminence of conditions which would prompt operative interference, and possibly the early breaking down of the gland and abscess formation, and thereafter, it gave an accurate forecast of the clinical condition observed forty-eight hours later. During convalescence azotorrhoea occurred in both cases. Visible steatorrhoea occurred only once and then during convalescence from the relapse in the first case, its absence possibly being due to the rigid exclusion of all fats from the dietary.

Diagnosis.—In 1900 Mr. Mayo Robson stated that “although pancreatic disease is without pathognomonic signs, the diagnosis can usually be arrived at by a careful study of the history, mode of onset and the combinations of symptoms and signs.” Fitz has said that “acute pancreatitis is to be

suspected when a previously healthy person or a sufferer from occasional attacks of indigestion is suddenly seized with a violent pain in the epigastrium, followed by nausea and collapse, and in the course of twenty-four hours by a circumscribed epigastric swelling, tympanitic or resistant, with slight elevation of temperature," and in 1903 he said in effect that we have no evidence "which gives to the diagnosis more than a variable degree of probability." In Case 1 the combination of the history, character of the original attack, and local signs pointed most clearly to acute pancreatitis after the matter of poisoning, perforative peritonitis, and finally acute obstruction of the bowels, could fairly be eliminated. Continued study of the developments in the case gave corroborative evidence of the diagnosis which was as positive as is possible in internal disease in advance of a demonstration at the operating or autopsy table. The diagnosis of the relapse was practically made by the patient before being seen by a physician.

In the second case the abdominal walls, though thick, were sufficiently lax on the first day to permit of a satisfactory deep palpation and the consequent knowledge of the ordinary local physical condition with the slight tenderness over the head of the pancreas to excite attention, and the later observations at frequent intervals, together with the history and symptoms led to a definite diagnosis. All subsequent events tended only to confirm it, even to the remaining sclerosis, recognized independently by others after her return home.

Treatment.—In the early stages of an acute attack with definite pancreatic enlargement and condition threatening, exploratory incision with drainage of the peri-pancreatic space, with possibly punctures or incision of the organ for the relief of the congestion, has, in a goodly number of cases, been followed by prompt recovery, apparently as a direct result of the treatment. Whether or not such treatment in the first case would have succeeded in averting the further progress of the disease and avoiding the subsequent suppuration we cannot say, but it should be noted that the condition was apparently not at all serious or threatening until the third day, when the bowels had not

moved and peritonitis appeared imminent. Then a voluntary movement of the bowels gave such evident relief that no interference was justified. The strictly medical treatment of this case appears, therefore, to have been eminently wise until the symptoms and the increasing mass pointed with almost unerring certainty to suppuration, when surgical intervention became imperative. At the operation the general cavity was protected, and the use of a large tube proved most satisfactory, efficiently carrying off the profuse irritating discharges and later the pancreatic juice. The protection of the skin from the discharges was most difficult and at times impossible. The treatment of the relapse as of the second case was symptomatic, consisting essentially in relief of pain, moving the bowels by repeated enemas and later nutrient enemas and restriction of the diet.

Conclusion.—The relapse in the first case, and the second case here reported ending in resolution, represent the milder forms of acute pancreatitis rather than the hemorrhagic, gangrenous and suppurative we have heretofore studied. This gland is doubtless pathologically subject to the same varying grades of inflammation as other tissues of the body, from simple congestion to the fulminating often fatal types mentioned. The slighter pathological changes in an organ so deeply and obscurely placed must ever be difficult if not impossible of detection without other aids than we now have. However, with a mind open to the fact that such milder inflammatory processes do occur in the pancreas; appreciating that, in the severer forms at least, as Mayo Robson says, a correct opinion can usually be arrived at, we shall be more alert to its occurrence, become better acquainted with its various clinical manifestations and succeed in recognizing acute, and probably sub-acute, pancreatitis much more frequently than heretofore.

PRIMARY FIBROMYOMATA OF THE BROAD LIGAMENTS.

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INTERLIGAMENTOUS development of fibromatous nodules originating from the uterus are common; but primary interligamentous fibromyomata, with no connection to the uterus either as to origin or development, are rare. So rare are these primary tumors of the broad ligament that for a long time pathologists did not admit their existence; and even yet there is confusion and uncertainty—even amounting to disbelief—in the minds of most operators as to the nature and existence of these tumors. It was thought for a long time that all such tumors originated from the uterus; that the nodule developing within the folds of the broad ligament became pedunculated and then gradually separated from the uterus by a narrowing of the pedicle till the separation was finally complete and the tumor assumed a purely interligamentous position, deriving its blood supply from the uterine and ovarian arteries within the broad ligament. But now, all doubt as to their origin is dispelled from the investigator's mind by a search of the literature on the subject.

Lack of knowledge in regard to these tumors is primarily due to their rarity, comparatively few surgeons ever encountering one, and secondly, to a lack of attention given these growths by the standard text books, the majority of which have nothing at all on this subject, and the rest containing such meager information as to not merit the attention of the busy worker.

Harpel¹ is of the opinion that these tumors are much more common than the few cases reported in literature would seem to indicate, and the writer is strongly of the same opinion, because a number of such tumors of primary origin, occurring associated with myomatous growths of the uterus, are over-

looked because they are regarded as having originated from the uterus, which, in the majority of cases, is probably not true; since, in the first place, it is very questionable whether a tumor originating from the uterus does not always retain sufficient pedicle or connection to the uterus to recognize its uterine origin; in the second place, the etiologic factors, whatever they may be, that cause the myomatous development of the uterus, by analogy at least, should be potent in the broad ligament also, and, as a matter of fact, the larger proportion of these tumors reported are associated with uterine fibromata, thus bearing out the above argument.

It is only in the cases of broad ligament development alone, associated with a perfectly normal uterus, that the primary origin is so obvious as to compel the attention of the surgeon. Such cases are very rare, there occurring only four in the past eleven years in American literature, so that the author feels justified in a rather extensive report of the following case, both because of the natural interest of the case and because it is such a beautiful and unmistakable specimen of primary fibromyoma of the broad ligament, accompanied by a perfectly normal uterus.

CASE REPORT.—Mrs. H., aged 47; married 18 years; two children, aged 17 and 6 respectively; family history good.

Personal History.—Usual diseases of childhood, otherwise always strong and well. Menstruation began at 14; was regularly established, lasting four to five days. She enjoyed perfect health till the birth of her first baby. The labor was long and hard, but delivery was normal. She gave a history of fever after delivery, and a week later she had an abscess in one breast, and later an abscess in the other breast. She was obliged to go to the hospital for treatment and remained there for six weeks. She was fairly well, she states, two months after her baby's birth, but she was obliged to go back to the hospital at the end of five months to be treated over a long period of time for "ulceration of the womb." No operation was performed.

The second pregnancy occurred eight years later. No miscarriages or abortions in the interval. With this second child she

had a normal period of gestation and a normal delivery. Her breasts were again sore, but no abscesses formed. Later she was again troubled with "ulceration of the womb." She was not able to nurse either of her children.

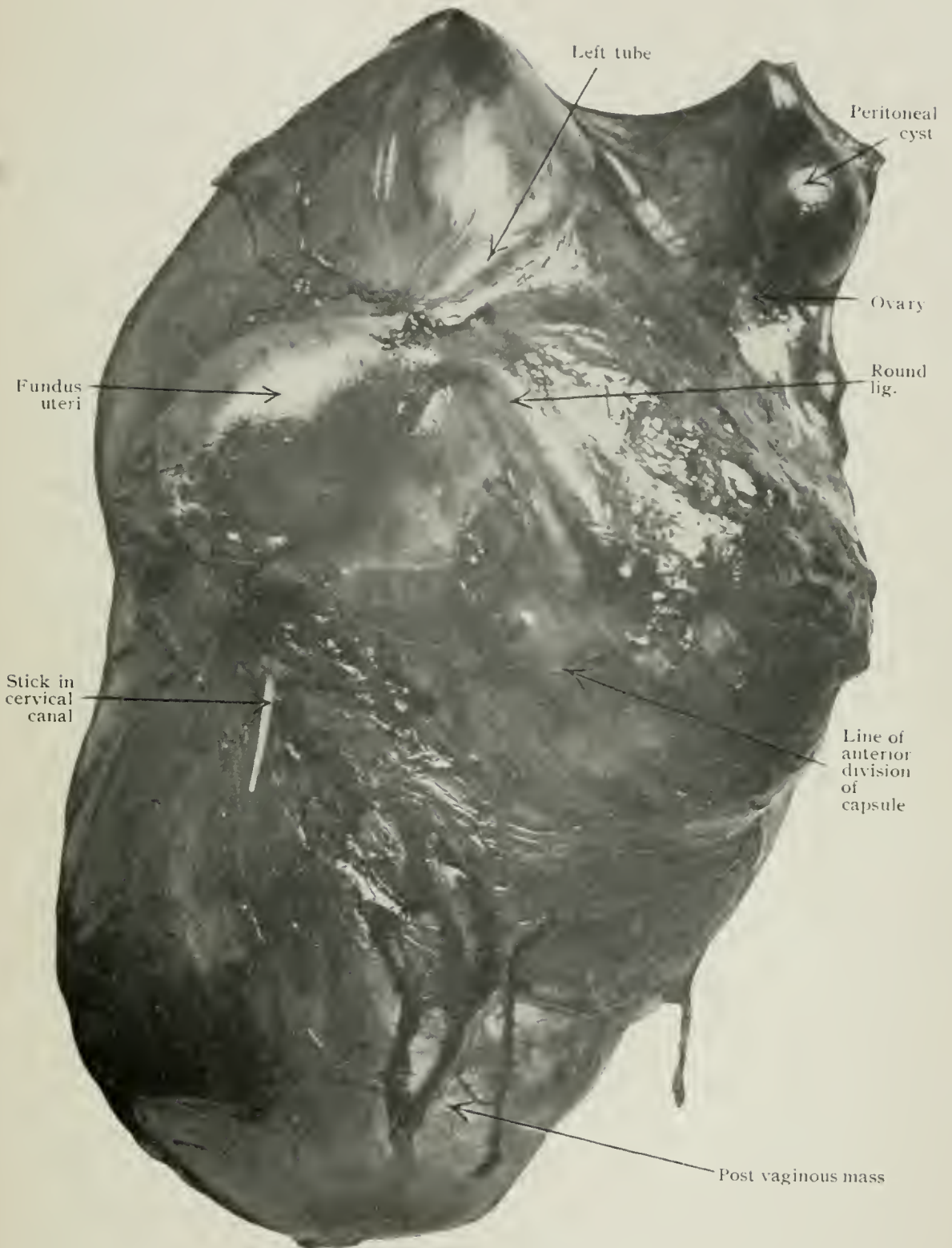
Present History.—About three years ago the patient noticed some "bloating" of the abdomen, but thought nothing of it. About a year ago she felt a "knot" in the right side above the pubes. She suffered no inconvenience from this, however, and did not even consult a physician.

During the past year there has rapidly appeared a "swelling" to the left of the original "knot." Menstruation during this time has been very irregular, both as to time and duration. She has developed pain in the back and radiating pains down the thighs. Frequent micturition has also given her great annoyance during past few months. She has had "stomach trouble" for more than a year past and a great deal of "bloating." Bowels have been regular generally, but lately she has had several attacks of diarrhœa. Appetite generally poor, but at times fair. She has lost about twenty pounds in weight during the past year.

Physical Examination, May 4, 1906.—Patient is about 5 feet 4 inches high. Her skin is very dark and dry. Sunburnt till her face is almost mahogany colored, showing outdoor life. Eyelids and mucous membrane of mouth show only slight apparent anæmia. Patient is thin, but not cachectic. Heart and lungs are normal; pulse 88, temperature normal. The abdomen is considerably distended in the lower portion by a mass which is neither soft nor hard; feels firm but gives beneath the fingers with the resilience of rubber. This mass extends to the umbilicus above, is easily palpated, and fits tightly into the pelvis below. There is no fluctuation, and the surface is smooth and even, except on the right side, about McBurney's point, where there is a nodule about the size of a large pear, which is smooth and slightly movable. There is no other nodule to be felt at any point.

The vagina is pushed up hard against the pubes so that the examining finger passes beneath the pubic bone with difficulty. There is a large resilient mass post vaginam. The whole pelvis is choke full—so much so that the tumor mass cannot be defined except at the ostium vaginæ and backward toward the rectum, which seems to be the lower border of the mass. The cervix is

FIG. 1.



Anterior view of tumor as removed.

felt with difficulty only, high up and to the right, well above the pubic bone. There is no traceable connection between the cervix and the nodule on the tumor above. The cervix has a deep laceration on left side, but is otherwise smooth and very little enlarged. Though the mass in the pelvis is apparently continuous with the tumor above, this cannot be certainly determined, since the whole mass is firmly fixed.

The patient was kept under observation for three or four days before operation, during which time the pulse ran between 86 and 100, but the temperature remained normal.

Diagnosis.—A probable diagnosis of uterine fibroid was made, because the whole mass lay in the median line of the abdomen and not more to one side than to the other, except the nodule, which lay well against the right abdominal wall, making a protrusion of the wall that was easily noticeable to the eye. The resiliency of the tumor suggested a cyst, and its relation to the vagina could only be explained as interligamentous. The nodule to the right, which was firmer than the rest of the tumor, was unquestionably a portion of the tumor, since its base was easily felt. Further the mass in the pelvis was more readily explained as a large myomatous nodule than otherwise, and it was difficult to explain how the nodule above could be that of a cyst.

For these reasons the diagnosis of fibroid of the uterus, as above stated, was made.

Operation, May 7, 1906.—The abdomen was opened and the nodule to the right proved to be the uterus only very slightly enlarged, perfectly normal in appearance and feel (Fig. 1). The right tube and ovary were normal.

The left tube wound over the top of the tumor backward and to the left, and was so changed in appearance as not to be recognized except from its position (Fig. 1). The ovary was all destroyed except a small portion about the size of a hulled almond, imbedded in the capsule of the tumor lying just below a small peritoneal cyst.

The uterus was not pedunculated but sessile in its relation to the tumor, and had the appearance of being imbedded in the tumor; only about three-fourths of the corpus, fundus, and right cornu projected from the tumor.

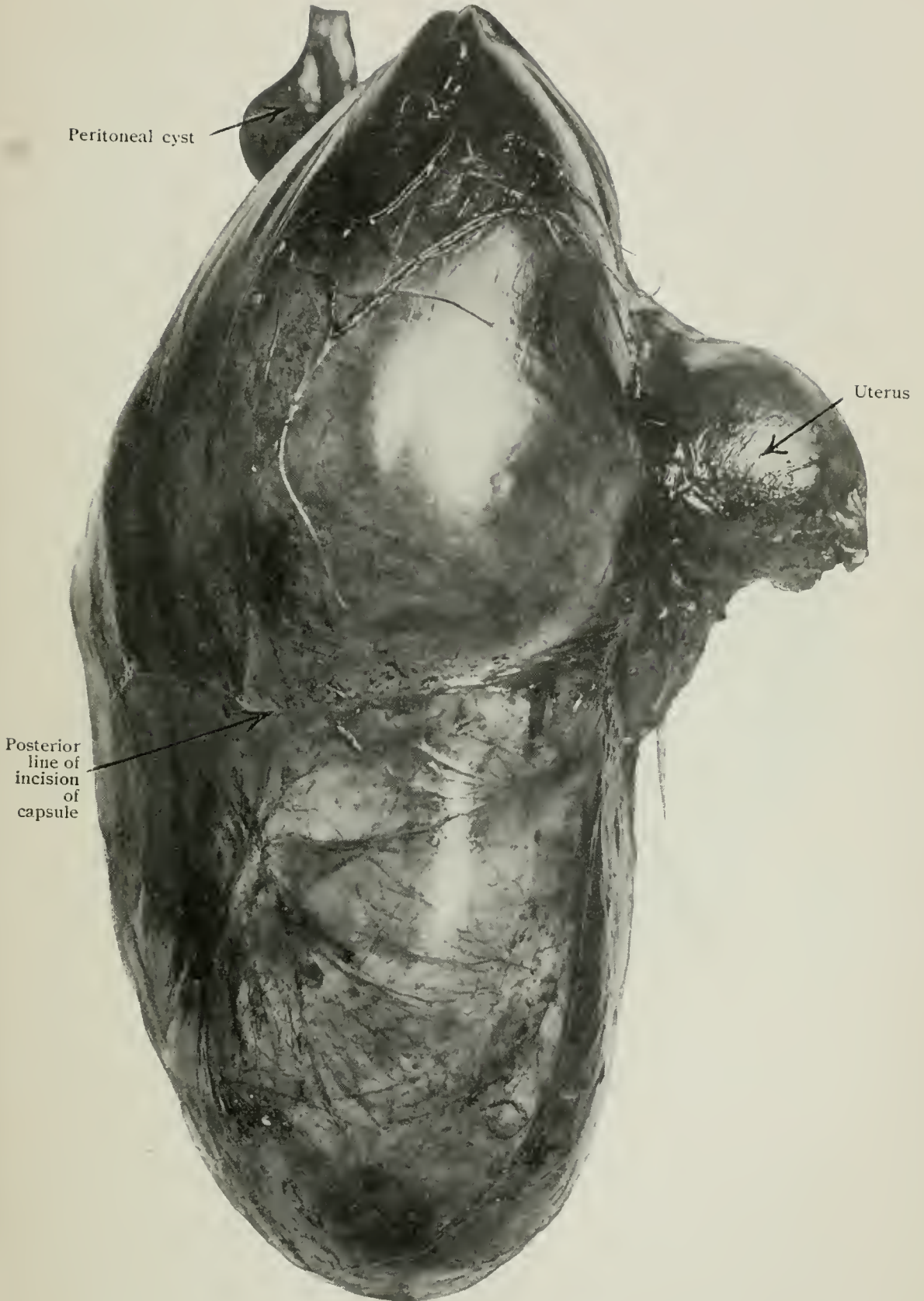
The tumor itself was almost immediately seen to be inter-

ligamentous. This was quickly proven by splitting the ligamentous capsule and enucleating a considerable area of the tumor. The resilience was so great and the feel so much like that of a thick walled cyst, and the probability of a cyst over any other form of interligamentous tumor so great that, without hesitancy (after carefully packing away the intestines with gauze pads) a knife was plunged into the tumor preparatory to inserting a trocar to draw off the fluid. There was a spurt of blood in a stream the size of my finger, clear over my head, showing the great pressure within the tumor. Immediate firm pressure with thumb over the stab controlled the blood sufficiently till the wound in the tumor could be closed with cat gut. The blood was bright red and the spurt like that of a large, severed artery.

Now that the nature (solid) of the tumor was determined, the ovarian vessels on the left were clamped, cut, and the capsule divided before and behind from this point to the junction of cervix and body of uterus. The next step was to clamp the right broad ligament and divide it between clamps down to the uterine artery which was easily exposed and ligated. This was done because the uterus was pushed up so high that it was very accessible. An incision through the peritoneum in front of cervix was then made, joining the uterine end of the incision made through the capsule of the tumor. A similar incision was made behind and the peritoneum pushed down. In front of the cervix the bladder was freed and pushed down with the peritoneum. The cervix, being small, was then clamped and severed. The tumor was then rapidly and easily enucleated by the fingers till it was all free, except where the uterine vessels entered the tumor to the left of the cervix. This attachment was quite large on account of the size of the enormously enlarged vessels. The tumor was then gently lifted up, exposing these vessels and the left ureter. The ureter was isolated and the vessels clamped *en masse* and the tumor cut away. All vessels were then secured with cat gut. A free incision into the vagina was made and the space left by removal of the tumor was drained by strips of gauze with the ends passed into the vagina. The layers of the broad ligament and peritoneum were closed over the gauze packing. The abdomen was then closed, completing the operation.

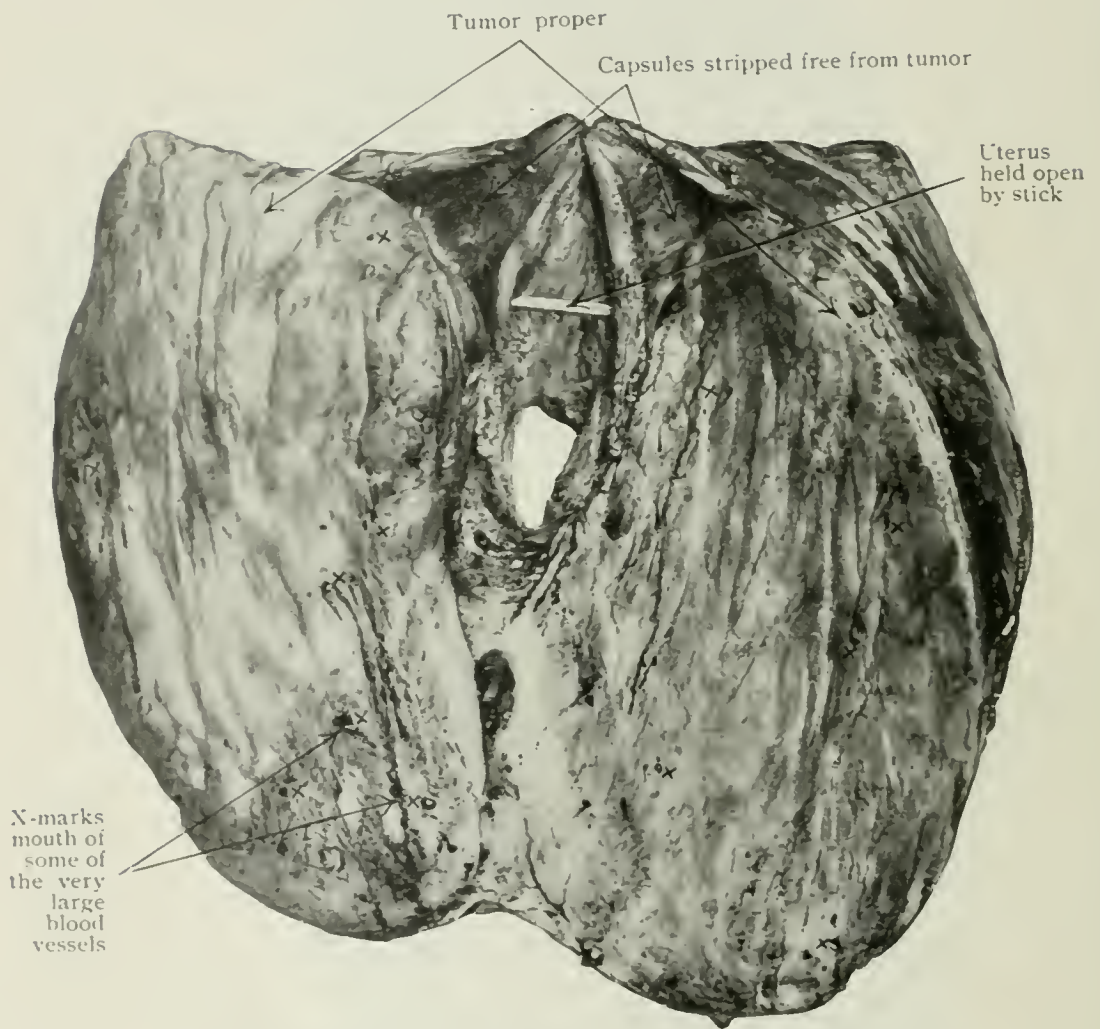
The tumor was when freshly removed, 12½ inches long, 8 inches wide, and 5 inches thick in greatest dimensions. The tumor

FIG. 2.



Side view.

FIG. 3.



Tumor divided through center. Note myriads of blood vessel mouths.

was so vascular as to closely simulate an angioma. The weight of the tumor and uterus was 12½ pounds. The uterus, I am sure, would not weigh over half a pound.

The tumor was photographed a few hours later, just as it was removed. It was then divided in its long axis from the left margin through the center of the tumor into the left cornu of the uterus, down into the body and cervix, then spread open and photographed (figure No. 3). The tumor proved to be a myofibroma, which did not touch the uterus at any point (see figure No. 3), but was entirely independent of a normal uterus and wholly within the folds of the broad ligament.

The tissue was tough to cut, but so full of blood vessels as to be soft and spongy to feel even after all blood was out of its substance.

The patient made an easy but slow recovery on account of long continued drainage per vaginam. The wound healed *primo initio* and the patient was strong enough to make, alone, a long railway trip home at the end of six weeks.

The patient's husband tells me that now, fifteen months after the operation, she weighs 145 pounds and is in excellent health.

Including the author's case, there are only twelve American cases reported, the first of which was by Burnham in 1867. During the past eleven years, beside the author's case, there are four reported cases, which are briefly as follows:

CASE I, HARPEL¹.—Patient 40 years old; married 17 years; no children. Up to seven years ago menstruation was normal and health good. Then menstruation was profuse and enlargement in left pelvic region, size of an orange. Two years ago some pain felt in that region and another attack a year later. A large, firm mass was found to the left and also several smaller myomata in the walls of the uterus. The tumor increased more rapidly from that time and she suffered more than previously from a sense of weight in that region, nervous reflexes, and at times distension of abdomen with gas. Menstruation profuse and then ceased altogether.

Operation.—The myoma and left tube were enclosed in a capsule in which were a number of cysts. A complete hysterectomy was done, leaving only the cervix. The total mass removed weighed 4¾ pounds after the contents of the cyst had escaped. The capsule which enclosed the tube and the growth weighed 4½ ounces. The left ovary could not be made out and undoubtedly because entirely cystic and adherent in this capsule. The myoma was situated in the left broad ligament, oval

in shape, $6\frac{1}{2} \times 5$ inches, and weight $3\frac{3}{4}$ pounds. It has a distinct capsule, grayish white in color, firm in texture, with a small area of mucoid degeneration in the center. There are three small cystic cavities deep in the mass and blood vessels on or near the surface. The uterus contained five small myomata in its walls.

CASE II, SHAW².—Miss L., aged 26; first noticed (tumor) enlargement of abdomen about 18 months ago, pain in region of right kidney, profuse and long continued hemorrhage. There was found a tumor somewhat irregular in shape, extending more to the right side than to the left, and upwards to within two inches of the ensiform cartilage. The entire pelvis was filled with the mass and the cervix could not be found. There were well marked pressure symptoms—irritable bladder, constipation, pressure in the rectum, and pain extending down the thighs.

On operation the mass was found to be firmly adherent to the bowels and bladder and involved the right broad ligament. The bladder was drawn over to the left and had a depth of nearly 10 inches. Attempts were made to separate the tumor from the bowels and bladder, but it was impossible to deliver it through the abdominal incision. The uterus, pushed upwards and to the left, seemed healthy, as were also the left ovary and tube. The broad ligament was clamped, ligated in sections close to the uterus and cut. The tumor was then removed as completely as possible with the scissors.

The tumor contained a dark, sanious fluid, the walls being of great thickness. It proved to be a fibroid on microscopical examination.

CASE III, BOVÉE³.—Tumor removed from a spinster of 37 years, who first noticed the growth six years before. She was anæmic from loss of blood and very nervous. The growth was somewhat fixed and extended from low down in the pelvis to the umbilicus. When the abdomen was opened, the mass was found to have developed in the right broad ligament, and was the largest of this variety he had seen. It was removed by Pryor's method of cutting down on one side of uterus and appendage, through the uterine body, clamping vessels as they appeared, and up on the other side. The ureter was first traced downward along the inner side of the growth and was avoided by the sense of sight during the removal of the growth. This operation is the best he knows for large, broad ligament fibroids, and if the location of the ureter is first ascertained, no danger of injuring it will likely occur during the operation.

CASE IV, GOLDSPOHN⁴.—*Aet.* 50; one child 30 years before. The condition within the vagina was very much that of a woman eight months advanced in pregnancy, with a very short, soft, stubby cervix presenting at the middle of the vaginal inlet, and the upper part of the cervix expanded. It appeared to be a uterus with one or more fibroids posteriorly, and also a cystic ovarian tumor in front of it. In making an incision about 4 inches in length, there was beneath the entire length of the incision something that looked very much like an ovarian cyst, very much engorged with veins, and different from a cyst, however, in its consistence, in not being membranous, but thin-walled, of rather doughy, edematous structure. Examining for its attachment, it was evident that

this mass was extraperitoneal, and it was soon demonstrated that it was the bladder; by simply squeezing upon it urine was extruded (several ounces) which could not be obtained by the catheter, which was passed immediately before making the incision. This patient had had retention of urine some three months ago, and at that time required to be catheterized for a week or more; and recently, before coming to the hospital, she was troubled in the same way for nearly two weeks, and she came with a very pronounced cystitis of old standing, which had infiltrated the bladder walls to that extent. The tumor was found to be a lobulated fibroid, two pieces separated completely from each other, the tumor having developed entirely within the right broad ligament. The uterus was not enlarged, as it usually is with a fibroid of this size, because the fibroid lay entirely outside of its walls and therefore she did not have the usual menorrhagia and metrorrhagia—a feature which cast some doubt upon the presence of a fibroid in the diagnosis. In removing the tumor he first ligated the ovarian arteries which were accessible; the bladder was then detached from the tumor anteriorly. But with the tumor in the broad ligament the uterine arteries were wholly inaccessible. He therefore simply incised the capsule of the tumor and enucleated that first. This allowed the whole mass in the region of the cervix to rise higher in the pelvis, and made it comparatively easy to ligate the uterine arteries and to do a supra vaginal amputation.

Pediculated interligamentous tumors are, anatomically speaking, entirely independent of the uterus, and are very rare, only nine cases appearing in the literature, which are briefly as follows:

CASE I, MIKULICZ⁸.—Nullipara 22, never menstruated, fibromyoma, 5 kg. in weight; extensive adhesions to omentum and transverse colon, pedicle, having the right ovary attached, was united with the right broad ligament. Tumor tissue highly edematous.

CASE II, SÄNGER⁶.—Girl, 19, double tumor, weight 8510 grm., attached left broad ligament by a short, narrow pedicle. Anatomical diagnosis, cystic fibromyoma. Left ovary was the seat of small, follicular cysts, but had no connection with the growth.

CASE III, BILFINGER⁷.—Autopsy case, fibromyoma right ligament pedicle springing from upper surface and hung from it "like an apple." No connection with uterus and ovaries, which were completely normal.

CASE IV, DORAN⁸.—Removed a ligamentous fibromyoma, weighing over 16 pounds, from a woman of 32 years. Close examination shows the ovary and tube beneath the pedicle, so that the tumor must have originated in the ovarian ligament.

CASE V, GROSS⁹.—Nullipara, 31 years, fibromyoma, having thick pedicle removed from posterior upper portion of right ligament. Ovaries and tubes normal, as well as the uterus. Tumor egg shaped, 2500 gm.

CASE VI, DOLÉRIE¹⁰.—Fibromyoma of broad ligament, having pedicle

5.6 cm. in length. Tumor was globular in form and contained numerous larger and smaller cysts.

CASE VII, *Arch. de Tocol. et de Gynec.*—Case reported of an hysterical person of 23 years. Removal of oval fibromyoma 9 x 6 cm. from upper border of right ligament, with pedicle two fingers breadth from uterus. All genital organs normal.

CASE VIII, L. TAIT¹¹.—Woman, 55 years. Tumor extirpated weighed over 2 pounds; attached by a broad, edematous pedicle to broad ligament, close to, but distinctly separate from the left margin of the uterus. On section, a considerable amount of fluid drained away. The edema spaces were smaller and more numerous, and there was less tendency to the formation of distinct cysts than in the uterine edematous myomata.

CASE IX, DELETREZ¹².—Woman, 42 years, single, for three months noticed enlargement of the abdomen and pain in right thigh. Palpation showed a hard, mobile tumor situated in the median line, below the umbilicus. On laparotomy a fibroid growth, weighing 2500 grms., "size of fist," was removed from right broad ligament, having a pedicle originating near the right side of uterus, which latter was normal; right ovary atrophied, left ovary contained multilocular cyst and was extirpated.

In looking over these nine cases of pediculated fibromyoma, a striking feature presents itself in that most of them were situated in upper portion of the ligamenta lata, *i.e.*, the ala vesperilionis. Sessile interligamentous tumors differentiate themselves clearly from the pedicled variety by having their seat usually in the middle portion of the ligament, which portion is richest in muscle supply and nearest to the uterus. This site of predilection explains the view taken by many authors in the uterine development of this form of tumor. At this site fibromyomata find the best soil for growth, not only by the abundant layers of muscle fiber tissue, but also the uterine artery, with its branches, furnishes copious material for nourishment.

Delétrez says the origin of these tumors has been long contested. Most pathologists consider them as neoplasms emigrating from the uterus to the ligament; others believe they originate in a fragment of ovarian tissue, or from an accessory ovary occurring by an anomaly.

The author has studied as the foundation of this paper twenty-six cases of primary fibromyomata of the broad ligament, sixteen of which have occurred in the past five years and are not included in the series collected by Säger, Doran, Senn, and Sutton, elsewhere alluded to.

ETIOLOGY.—European literature is much richer in these tumors than American, there appearing eight cases in the French literature alone during the past five years. Several occur in German and a few in English literature during the same period.

Sänger ¹³ was the first to demonstrate that these tumors of the broad ligaments form a group to themselves, basing his conclusions on clinical and anatomical grounds, while Virchow ¹⁴ was the first to describe clearly and definitely the occurrence of fibromyomata at this site. He himself found a fibroma the size of a bean, of characteristic structure, in the ala vesperitilonis immediately above the ovarian ligament, and far away from the uterus and fallopian tube, thus showing definitely the ligamentous origin of the growth.

Numerous authorities are cited by Krekels ¹⁵ to show the independent origin of these growths. That fibromyomata are found within the broad ligament, as well as in the uterus, is natural since the same smooth muscle fibres and connection tissue are found here as in the uterus.

ORIGIN.—According to Burkard ¹⁶ the most frequent site of origin of fibromyomata of the broad ligament is in that portion nearest the uterus since there exists at this location the greatest abundance of muscle tissue. More rarely they spring from the ala vesperitilonis, in which event they are pedicled, whereas the former are sessile. Fibromyomata of the peripheral portion of the broad ligament, *i.e.*, the infundibulo-pelvic ligaments where muscle tissue is very scant, are very rare. Burkard ¹⁶ reports such a case in which the tumor, the size of "two fists," was accompanied by a hypernephroma of the same side of 30 years standing, while the fibroma was of 15 years growth. This growth is looked upon as a curiosity and Burkard thinks it possible that the hypernephroma had some genetic influence upon its development.

AGE.—The most frequent occurrence is between the ages of 30 and 50 years. Doran ¹⁷ in analyzing 39 collected cases found 6 below 30 years, and the same number above 50 years of age. In the series of 16 cases collected by the writer, the

extremes of age are 22 and 56, of which three occur before 30 and two after 50 years. It is evident from studying this subject that the age of development corresponds in every respect to that of uterine fibroids which was to be expected.

PATHOLOGY.—Fibromyomata occasionally obtain an enormous size, thus Doran ¹⁷ reports his case in which the tumor weighed 44½ pounds. In 24 others he gives the weights as follows: Two between 30 and 40 pounds; two between 20 and 30 pounds; ten between 10 and 20 pounds; eight between 1 and 10 pounds; and two below 1 pound. In my own series, collected from the literature of the past five years, the tumors are generally small, as is to be expected since operative treatment is so much more readily and quickly submitted to now than formerly. My own case of 12½ pounds seems to be about the largest of the American cases.

GROWTH.—Growth is generally slow, though it may occasionally be very rapid. As an example of the former, Chardon ¹⁸ reports his case as having been observed for twenty years before removal, at which time it was still a comparatively small tumor, measuring 15 x 25 cm. Pollosson ¹⁹ also reports his case as having been under observation for 15 years prior to operation, and numerous other authors comment upon the slowness of growth. On the other hand, as an example of rapid growth, Duroux ²⁰ reports his case of a large fibromyoma of the ligament which grew so rapidly as to have a clinical history of only 11 months. So rapid was the growth that Duroux was led to make the diagnosis of ovarian cyst.

From studying not only my own series but those of others, collected prior to this, it is evident that in point of growth, as well as in other respects, broad ligament fibromyomata closely resemble those of the uterus in that they, as a rule, grow slowly, especially until after they have obtained considerable size, when at some inexplicable point, sometimes due to adhesions formed, growth becomes rapid. The soft, myomatous form, as in the uterus, grow more rapidly than the denser, more fibrous tumors. The author's case, a typical soft myoma, is a good example of growth in this kind of tumor in which

case growth was very rapid for three or four months prior to removal.

MORPHOLOGY.—The small growths are nearly always mononodular and more or less ovoid in form, while the large ones are frequently lobulated rather than nodular. This lobulation is noted frequently by reporters, notably Doran and Polloson.

The growths are surprisingly constant in being unilateral, though bilateral tumors do occur as is evidenced by the case reported by Thiery,²¹ in which two fibroids—one on either side of uterus—were removed. It is interesting to note that in this case the uterus was enlarged (twice normal size) though the tumors had no connection to uterus, and the patient suffered from metrorrhagia, which is very unusual. I find only this one case in which the growth was bilateral whereas we would expect the condition commonly.

Histologically, fibromyomata of the broad ligament correspond exactly to uterine fibromyomata, the growth consisting of smooth muscle fibres and connective tissues irregularly distributed. Macroscopically, therefore, the cut surface is firmer, whiter, and more glistening in proportion to the predominance of connective tissue, or redder, softer, and duller when the muscular element exceeds.

These tumors usually have much less fibrous tissue than the corresponding uterine tumors, consequently they are softer, often having a peculiar resiliency not unlike rubber. This is frequently noted by authors, as, for instance, Krekels reports Sanger as having a case in which the tumor was so resilient as to stretch like rubber; and, in the author's case, the resiliency was strikingly noticeable.

Edema of the tumor tissue is by far the most frequent metamorphosis, it having been found present in many cases reported. A very peculiar pathologic condition may arise from a transudation of the fluid within these edematous fibromyomata into the surrounding loose connective tissues, and from there into the natural channels leading to the openings of the vulva, perineum, or inguinal canal and thus produce a condi-

tion simulating hernia. Stern ²² describes three such cases as happening in Von Langenbeck's clinic and five such cases were observed by Schröder. In one case a portion of the tumor appeared at the right vaginal wall into the introitus vaginae.

Nerow ²³ published an interesting case in which the patient, aged 44, came to treatment for complete rupture of the perineum and prolapse associated with two small fibromyomata to the right and left of median line, causing bulging of the vaginal wall, which were removed per vaginam, and found located in the connective tissue between the cervix, lateral pelvic wall, and bladder.

DEGENERATIONS.—Cystic degeneration is quite common in fibromyomata of the broad ligaments, the cystic accumulation of fluid being found in large quantities in a few cases, notably so in the cases reported by M. Chardon ¹⁸ and Tédénat. ²⁴ In the former, there were 12 litres of transparent, yellowish sero fibrinous fluid, and in the latter 8 litres. Usually, however, the fluid is dark in color and small in quantity. Kelly ²⁵ reports a case in which the cyst contents was pus.

Demons ²⁶ and Wathen ²⁷ each report a case of calcareous degeneration, while Harpel's ¹ specimen showed mucoid degeneration. Fatty degeneration is also noted by Konrad, ²⁸ in a soft myoma of left broad ligament, weighing 20 pounds. Mikulicz ²⁹ reported a case in which the tumor, the "size of a man's head," of the right broad ligament, had no connection with uterus or ovaries, although on the ovarian side the tumor contained a small, dermoid cyst.

These tumors seem to be always benign; in no instance have I been able to find a case reported of malignant degeneration.

DIAGNOSIS AND TREATMENT.—The diagnosis of fibromyomata of the broad ligament is more or less difficult even when small, and when large the diagnosis is practically impossible till the abdomen is opened. The symptoms are so uncertain and so variable that little assistance is given from this source. There are a few symptoms, however, which are suf-

ficiently constant to be well worth noting. The unaffected condition of the menstrual function is the most constant symptom, this being remarked upon by almost every author of reported cases in which the uterus was normal. In the author's case the disturbance of menstruation was almost certainly due to approaching menopause. When the uterus is also fibroid, there is metrorrhagia, just as in a fibroid uterus uncomplicated by broad ligament fibroids. Pain occurs only from pressure and crowding of tumor or incidental inflammations of the tumor or neighboring organs which bring about adhesions. Slow growth is the third symptom of importance, and has already been discussed.

Doran says the patients are usually thin and anæmic, although "flooding" does not occur.

The diagnosis where made is nearly always arrived at by the physical examination which, when the tumor is small, may not be difficult.

The treatment is complete removal by operation, the prognosis of which is most excellent, there not being a single death reported from this operation for many years.

Monod³⁰ refers to 200 cases collected by Strokeker in 1902 in which the mortality was 22.2 per cent (77 cases, 17 deaths) by simple removal, while it was only 12.2 per cent. (57 cases, 7 deaths) when removal was accompanied by hysterectomy. Most of these deaths occurred prior to 1890.

Doran, in his series of 39 cases, reports 6 deaths in 12 cases of simple enucleation of tumor, all occurring before 1890.

OPERATION.—In the great majority of cases it is necessary to remove the uterus along with the tumor, because hemorrhage is so much more easily controlled and further, if the tumor is removed alone, the uterus is left without support on that side, which is liable to be followed by all kinds of malpositions and adhesions which will prevent the perfect recovery of patient. Castaing and Philippe³¹ report such a case. After the simple removal of a 7-pound fibromyoma from left broad ligament, it was found necessary later to remove uterus and adnexa at a second operation.

The operation itself is, as a rule, easy, the most troublesome feature being the avoidance of the ureters. In most cases this is easy by simple enucleation of tumor by the fingers, after capsule is opened on a line between the point of ligation of the ovarian vessels, at the pelvic wall and the uterine cornu. The ureters are nearly always displaced by the growth and in cases of dense adhesions their avoidance may be very difficult, as is shown by the case reported by Thiery,²¹ in which the fibromata were bilateral and exceedingly difficult to remove on account of ureters which had to be dissected away from tumors on both sides for about 15 cm. Urinary fistula through abdominal wall followed, which closed on fifteenth day after operation. Recovery.

This operation may be made difficult by adhesions to omentum, intestines, or other organs, especially noticeable is Billroth's case reported by Buschmann,³² in which an 18 kg. fibromyoma of left broad ligament was so densely adherent to the left kidney and adnephrium that complete removal of those organs with the tumor was necessary, as every effort to separate them was futile on account of hemorrhage. Adhesions to bladder and abdominal wall are noted as making the operation very difficult in the case reported by Rydyggier;³³ but, as a whole, these tumors are remarkably free from adhesions, which is natural since their site of origin is not connected with any external source of contamination, as are the ovaries and uterus.

Although numerous authors have described the technic of the operation, which is essentially the same by all operators, with modification to suit the individual case, it does not seem profitable to discuss these various modifications of operative procedure, since, in recent years, all methods seem to have been equally successful.

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THE RENAL CATHETER AS AN AID IN THE DIAGNOSIS OF VALVE-LIKE OBSTRU- TION OF THE URETER.

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It is not the purpose of this communication to review the many ways the renal catheter may be employed as a means of diagnosis in diseased conditions of the kidney and ureter, but to report two cases of valve-like obstruction of the ureter, and demonstrate how it was used in these two cases.

Dr. H. A. Kelly has not only contributed greatly to the development and perfection of cystoscopy and the catheterization of the ureters in women, but he has also described two especially valuable methods of diagnosis, made possible by the use of the renal catheter. The first of these is the use of the wax tipped catheter as a means of detecting ureteral and renal calculi. This was first published by him¹ in 1895 and in a later communication² he reported twenty-four instances in which the presence of a calculus had been determined from the scratch marks on a wax tipped catheter. By this method calculi have been detected when the X-ray picture has failed to show any shadows suggesting them, and shadows have been present in an X-ray picture, suggesting calculi in the lower end of the ureter, which, after the failure to detect their presence by means of the wax tipped catheter, were shown to have arisen from phleboliths in the veins of the broad ligament. The wax-tipped catheter, as a means of detecting urinary calculi, cannot entirely take the place of the X-ray, for a calculus in a renal calyx or a small one in the pelvis of the kidney may easily fail to come in contact with the wax on the catheter and so escape detection. Other sources of failure in detecting calculi by this method have been fully described by Dr. Kelly.³ The X-ray

picture, when positive, also gives more exact information, such as the size, number and situation of the calculi which cannot be determined by the other method. On the other hand, even at the present time when the technique of radiography is so efficient, the wax tipped catheter gives most valuable information and often enables one to confirm or disprove the results of the X-ray.

The second diagnostic method, devised by Dr. Kelly, is of even greater value and is capable of a wider application than the former. This method is the use of the renal catheter as an aid in determining the seat of obscure pain in the side, by producing artificial renal colic through forced injection of the renal pelvis. The patient is able to state whether or not the symptoms, arising from the distension of the pelvis of the kidney by means of sterile fluid forced through a renal catheter, are similar to or different, both in character and location, from those from which she suffers. This method was presented to the American Gynecological Society in May, 1899. At that time six cases had been investigated by this means and were reported ⁴ in full. Later H. T. Hutchins reported ⁵ one hundred cases, from the records of Dr. Kelly's private sanitarium and the Gynecological Clinic of the Johns Hopkins Hospital, which had been studied in this manner. Hutchins' communication is of especially great value as he has carefully studied and described the character and location of the pain arising from the injection of the pelves of normal kidneys under various degrees and rates of distension.

In the two cases about to be reported I wish to demonstrate a further development of the two methods of diagnosis just mentioned.

CASE I.—Mrs. S. M., aged 57, Johns Hopkins Hospital, Gyn. No. 10860.

Diagnosis.—Stricture of the intra-mural portion of the left ureter with a secondary valve-like obstruction at the pelvic brim.

Treatment.—Resection and re-implantation of the ureter into the bladder, release of the "kink" at the pelvic brim, both by the extra-peritoneal inguinal route, through a "gridiron" incision.

History of Case.—The patient complained of severe attacks of pain in the left side and back. She was transferred from the Medical to the Gynecological Clinic of the Johns Hopkins Hospital on November 9, 1903. (At that time I was resident gynecologist at that Hospital.) Past history was of little value; married, six children, oldest thirty-six and youngest twenty-six years of age. There was no record of any illness until the present one.

Present illness began in May 1902 with attacks of severe pain in the region of the left kidney. At first the pain did not radiate and there were not any urinary symptoms. These attacks had been increasing in severity and in frequency, and in the later ones the pain had radiated from the region of the left kidney down towards the bladder. She was unable to void during or just after one of these attacks. There had never been any blood in the urine nor had she passed any calculi, although her attacks had been diagnosed as renal colic. The patient was studied in the ward and had two of these attacks in five days. These seemed to be very severe and were controlled by large doses of morphia. The examination of the urine showed it to be normal.

The patient's general condition was apparently excellent. She was very large and the physical examination was unsatisfactory. While no mass was felt in the region of the left kidney (abdominal walls were very thick) there was tenderness in this region and along the course of the left ureter.

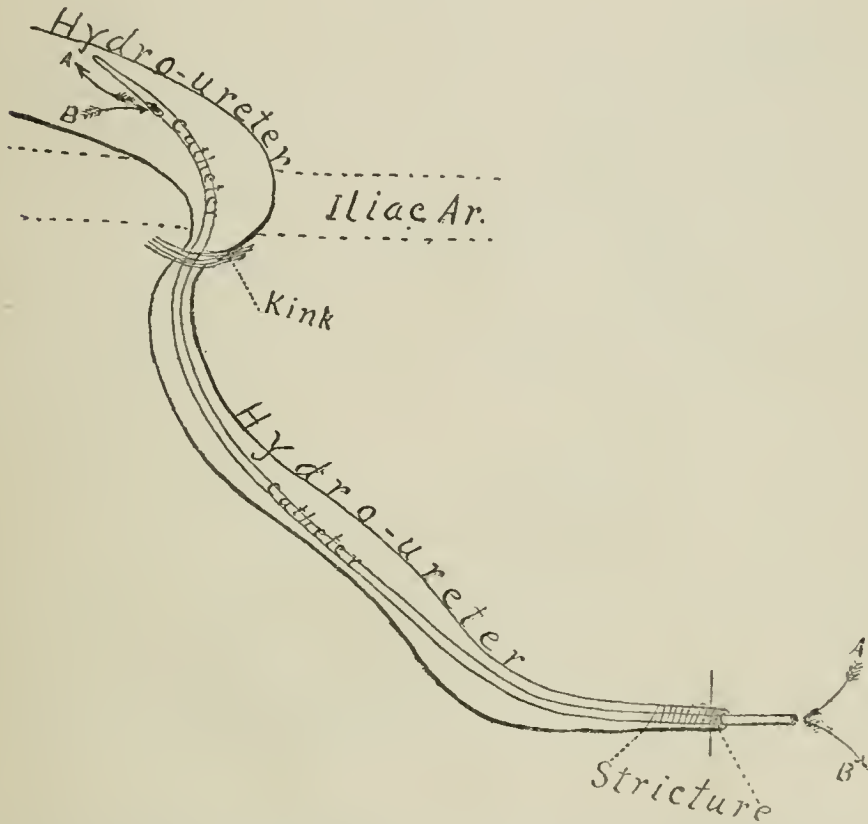
November 16, 1903, I made a cystoscopic examination; patient in the knee-chest posture. The bladder, including both ureteral orifices, appeared to be normal. Repeated attempts to catheterize the left ureteral orifice failed. There seemed to be a stricture of the intra-mural portion of the ureter. A few hours after this examination, the patient suffered from the most severe attack of pain she had ever had and it was necessary to anæsthetize her with chloroform in order to relieve her. The attack did not cause any elevation in temperature or increase in pulse rate.

Observations which should have led to the diagnosis of ureteral stricture and secondary "kink," with valve-like obstruction, November 18, 1903.

As a result of the previous examination it seemed evident that there must be a stricture of the intra-mural portion of the

ureter and the question arose as to its cause. A small ureteral catheter with a filiform point was chosen. The wax, used for "tipping" the catheter for the diagnosis of urinary calculi, was melted and by means of sterile forceps four drops of the melted wax were applied to the catheter at intervals. The entire catheter was warmed by passing it through the flame of an alcohol lamp

FIG. 1.



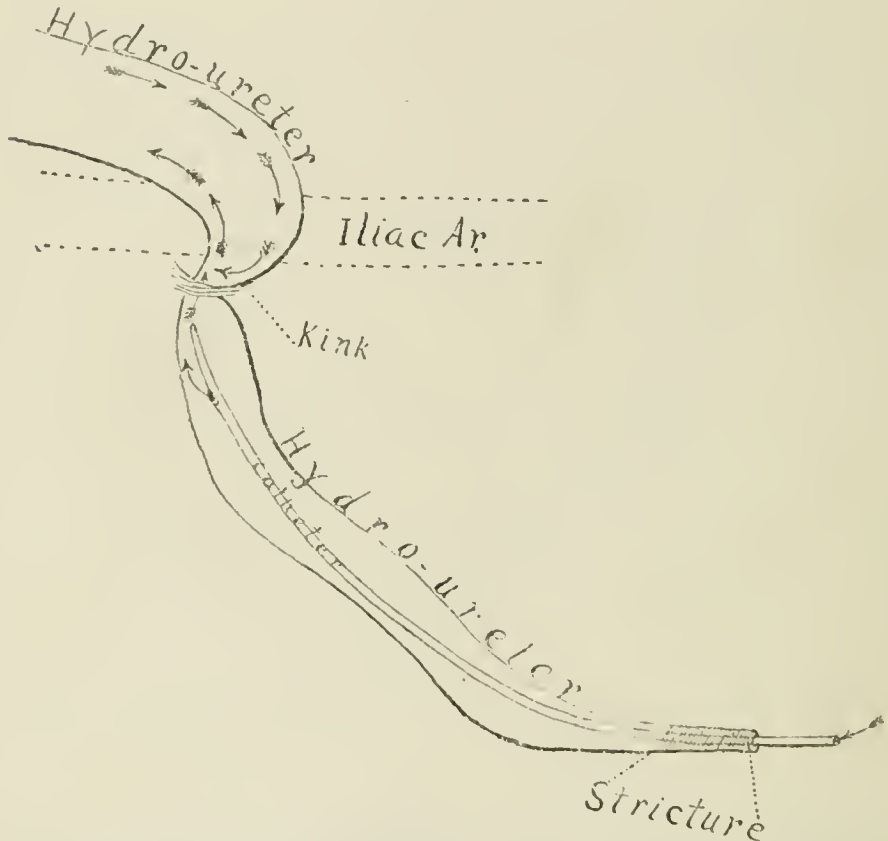
Stricture of the intra-mural portion of the ureter with hydro-ureter and valve-like obstruction of the ureter at the pelvic brim, $\times \frac{3}{4}$.

This illustration represents the condition found in the first case. The stricture (cause not determined) of the intra-mural portion of the ureter, gave rise to a tortuous hydro-ureter above. This tortuosity was so great as, in places, to cause a form of hernia of the ureter through the tissues surrounding it (its sheath) with a consequent "kinking" of the ureter where its displacement was most restricted. A small renal catheter was introduced with difficulty, the distance indicated. Artificial renal colic was induced by injecting fluid through the catheter and the patient was again relieved by permitting the fluid to return through the catheter as indicated by the arrows A and B.

and at the same time the drops of wax attached to it were melted, and then by tipping the catheter up and down the melted wax flowed over the entire catheter and coated it with a fine coat of wax which increased but very little its diameter. This represents but a further development of the wax-tipped catheter of Dr.

Kelly and one which I have used for the detection and localization of calculi in the ureter. The catheter easily passes the calculus and the wax coating is scratched for the distance it extends beyond the calculus. By taking measurements one is able to estimate the situation of the calculus. A calculus so detected and located by the author has been reported.⁶

FIG. 2.



Further observations in Case I, which should have led to the correct diagnosis, x $\frac{2}{3}$.

On slowly withdrawing the catheter (shown in Fig. 1) the return flow suddenly ceased when the eye of the catheter had apparently been drawn past the "kink," see Fig. 2. Artificial colic was induced with the catheter in its present position, but only a small amount of the fluid was returned (that from the pelvic portion of the ureter). The large amount which had extended beyond was prevented from returning by the "kink," which acted as a valve and the greater the distension above, the more efficient the valve. The condition was relieved by pushing the catheter further up the ureter when the fluid gushed from the end of the catheter, thus indicating that the eye of the catheter was then situated above the "kink."

Through a Kelly cystoscope, the patient in the knee-chest posture, the wax coated catheter was inserted into the left ureteral orifice and with considerable difficulty it was passed up the ureter for a distance of about 10 cm. when it apparently encountered another obstacle. After a little more manipulation this was passed and urine escaped freely from the catheter. This

caused me to think that there were two strictures present, instead of one. The patient now assumed the Sim's posture (more comfortable) and artificial hydronephrosis was induced by injecting sterile fluid through the catheter as described by Dr. Kelly. This procedure caused an attack of pain which was similar in every way to those from which the patient suffered. On permitting the fluid to escape from the catheter, the patient was instantly relieved (see Fig. 1). The catheter was then partially withdrawn (Fig. 2), and on again injecting fluid into the ureter an attack similar to the first one was produced but on permitting the fluid to escape only a very small amount came away (probably only that in the pelvic portion of the ureter) and the patient was not relieved. After waiting, in vain, a few minutes for the escape of the fluid the catheter was withdrawn. As the patient was still in pain the ureter was catheterized again and after passing the same distance into the ureter as before, fluid gushed from the end of the catheter affording great relief to the patient.

It was evident, from this examination that there was a stricture of the intra-mural portion of the ureter and an obstruction at or near the pelvic brim which permitted fluid to pass it from below upwards but prevented its return. The absence of scratch marks on the wax coated catheter excluded the possibility of either obstruction being due to a calculus.

Operation with description of condition found, November 21, 1903.

Under ether anæsthesia, an incision was made through the skin parallel to the left Poupart's ligament, and the fascia and muscle of the abdominal wall were separated forming a so-called gridiron incision (as in the well-known McBurney incision) down to the peritoneum. The latter was now pushed back from the abdominal wall and the side of the pelvis. The uterine artery was ligated and cut and the left ureter was exposed from above the pelvic brim to its entrance into the bladder. It was dilated and especially the portion above the pelvic brim, where its diameter was nearly 1.5 cm. The ureter was very tortuous and just beneath the pelvic brim a distinct kink was present which was caused by connective tissue crossing the ureter and above this kink occurred the greatest distension of the ureter. The condition present seemed to have arisen as follows: The ureter

through its peristalsis tends to form a sheath from the tissue about it. This sheath varies with the tissue along its course and cannot be considered as a distinct structure belonging to the ureter. It is more marked in some individuals than in others and is usually better formed about the pelvic than the abdominal portion of the ureter. For these reasons the sheath can sometimes be definitely demonstrated in cross section and in other instances not. This sheath is of very little importance but occasionally plays an important rôle in pathological conditions, as has been previously emphasized⁷ by the writer. In this patient a stricture (cause not determined) was present in the intra-mural portion of the ureter. The obstruction to the outflow of urine gave rise to distension and an increased tortuosity of that duct. A kink apparently arose from a tortuous part of the ureter breaking through a weak portion of its sheath, *i.e.*, a hernia, and the lower portion of the hernial ring was formed by the stronger structures of the sheath which did not give way but held the ureter in place at that spot. The kink occurred at the lower end of the abdominal spindle, *i.e.*, at the situation of a natural constriction of the ureter.

The fibres causing the kink were severed, the ureter freed and immediately the kink disappeared. A small incision was made in the upper part of the pelvic portion of the ureter and a medium sized renal catheter was passed towards the bladder but could not be made to enter that organ. The ureter was cut off just above the bladder, and after excising enough of it so as to reduce its tortuosity, it was re-implanted into the bladder in the following manner. A pair of long artery clamps was introduced through the urethra, pushed against the bladder wall just above the original insertion of the ureter and the bladder was incised at this place. The forceps were then pushed through and made to grasp the end of the ureter which had been split for a distance of .5 cm. This was then drawn into the bladder for a distance of about 2 cm. and held in place while the bladder wall was sutured to that of the ureter with fine silk, taking care not to compress the latter. A renal catheter was now passed into the bladder through the opening made in the ureter and drawn through the urethra. The opening in the ureter was closed with one silk suture and the field of operation drained with iodoform gauze.

Post-Operative Course.—A urinary sinus developed through the inguinal incision, apparently from the opening in the ureter. The patient left the hospital on December 23rd with a slight urinary discharge which was not constant. This discharge ceased entirely in the early part of January, 1904, and the patient felt completely relieved. At about that time (date not present in the records) a cystoscopic examination was made and the end of the ureter could be seen projecting from the bladder wall for a distance of about 1.5 cm. Attempts to catheterize this failed and fearing that so long a portion of the ureter projecting into the bladder might act as a foreign body and cause trouble, about half of it was amputated by means of a nasal wire snare introduced through a Kelly cystoscope. On January 28, 1904, another cystoscopic examination was made. The ureter now projected about .5 cm. into the bladder, it could be seen to retract and urine spurted from it as from a normal urethral orifice and a medium sized renal catheter was inserted without difficulty.

In a letter received from the patient in April, 1907, over three years after the operation, she stated that her general health was excellent, she had not had any attacks of "renal colic" but that she occasionally had some pain low down in the left inguinal region and especially after taking long walks.

CASE II.—Miss F. S., aged 20, Gyn. No. 11001.

Diagnosis.—Probable valve-like obstruction of the upper end of the ureter, diagnosed by means of the renal catheter.

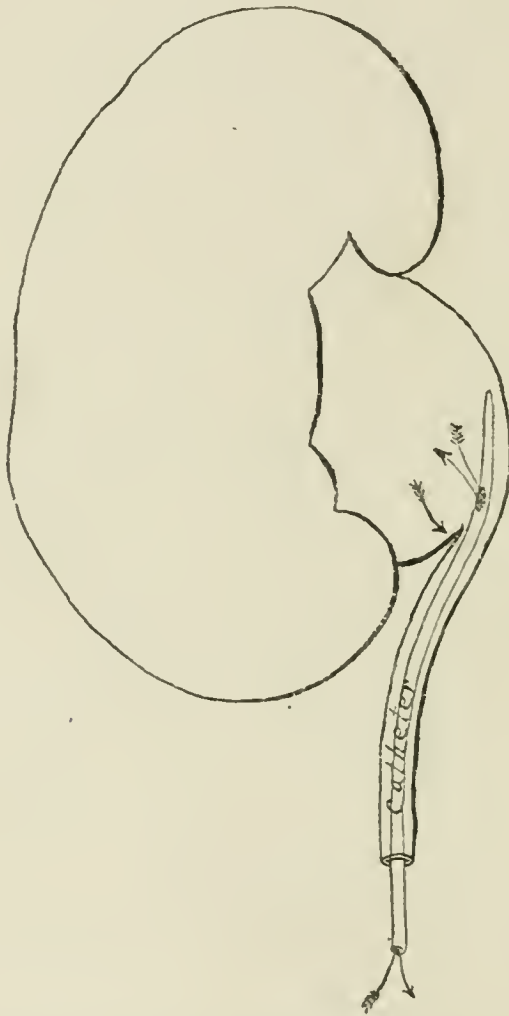
Treatment.—Dilatation of the upper end of the ureter by means of graduated bougies (olive and spindle-shaped enlargements of wax on renal catheters).

History of the Case.—The patient has already been referred to in a publication² by Dr. Kelly showing the value of the wax-tipped catheter as a means of detecting renal and ureteral calculi, under cases Nos. 19, 22, 27, and 33 of that article. She had been operated upon by him four times, three nephrolithotomies, twice on the right kidney and once on the left, and at the last operation in October, 1903, an exploratory nephrotomy of the right kidney was made and also the upper end of the ureter was freed. Nothing was found in the last operation to account for the pain in the right side; both X-ray and wax-tipped catheter were negative for the right kidney but the X-ray showed a calculus in the left kidney from which the patient did not have any symptoms.

The patient was re-admitted in January, 1904, and stated that she had had six severe attacks of pain in the right side since she left the hospital the previous November.

The following report is from records of observations I made of the case during her last admission and demonstrate some of

FIG. 3.



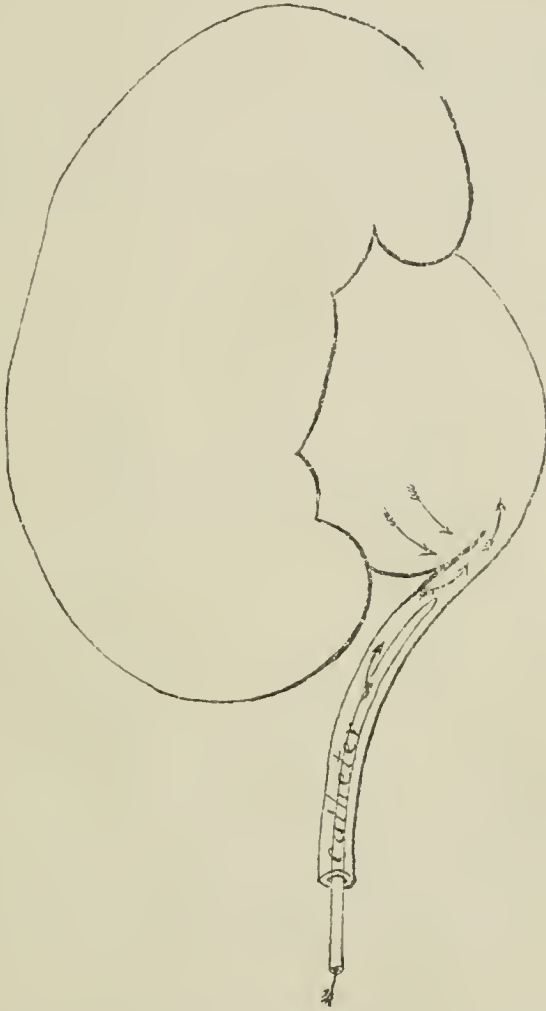
Probable valve-like obstruction at the origin of the ureter from the renal pelvis, $\times \frac{2}{3}$.

This illustration represents the condition possibly present in the second case. As in the case represented in Fig. 1, artificial renal colic could be induced and again relieved by permitting the fluid to return through the catheter, which extended into the pelvis of the kidney.

the possibilities in the use of the renal catheter. These observations were not confirmed by operation. It must be remembered that calculi had been removed from the right kidney twice and at the last operation an exploratory nephrotomy had failed to reveal any and the X-ray and wax-tipped catheter were negative.

On January 27, 1904, patient in the Sim's posture⁷ (in this case this posture was as serviceable as the knee-chest and was easier for the patient) a cystoscopic examination was made and the right ureter was easily catheterized with a large renal catheter. The catheter was passed up into the renal pelvis and artificial renal colic was

FIG. 4.



Further observations in Case 11, which led to the probable diagnosis, $\pi \frac{2}{3}$.

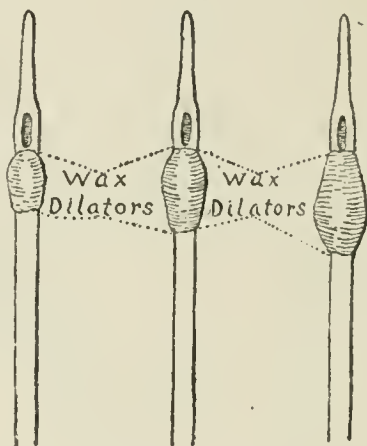
On slowly withdrawing the catheter (shown in Fig. 3) the return flow suddenly ceased when the eye of the catheter had apparently been drawn past the "valve," see Fig. 4. Artificial colic was induced with the catheter in its present position, but only a small amount of fluid was returned. The condition was relieved by passing the catheter up into the pelvis of the kidney.

caused by injecting sterile fluid through the catheter. This caused pain similar to that from which she suffered and she was relieved by permitting the fluid to escape from the catheter (see Fig. 3). Bearing in mind the first case, the pelvis was again

distended with fluid and then the catheter was slowly withdrawn a short distance when suddenly the fluid ceased to flow and the patient was not relieved. After waiting a few minutes for the fluid to appear, I attempted to re-introduce the catheter into the pelvis of the kidney, failed at first but finally succeeded. It seemed that there must be present a valve-like stricture or kink near or at the renal pelvis which prevented the outflow of urine when the pelvis was distended (see Fig. 4).

The patient refused to be operated upon. On the other hand, she consented to attempts to dilate the upper end of the ureter. Dilators were devised by making spindle enlargements of wax on the ends of large renal catheters just below the

FIG. 5.



Wax dilators on the end of renal catheters, used in dilating the ureteral "valve" in the second case, natural size.

These were made by applying melted wax to each catheter, just below its eye, and then moulding the wax by turning the catheter in the flame of an alcohol lamp. As "olive-tipped bougies" they may be felt to "hitch" over any narrowing of the ureteral lumen, and by passing them to and fro into the renal pelvis, of the second patient especially, when the pelvis was dilated, thus narrowing the valve-like obstruction or "kink," the efficiency of this "valve" was apparently destroyed. Artificial renal colic could be induced and the patient relieved, even though the end of the catheter was not in the pelvis of the kidney. The patient has not had any attack of pain in the region of the kidney since their use (over three years ago).

eye so as not to obstruct the lumen of the catheter (see Fig. 5). These dilators were easily passed up the ureter in this case, even dilators having a diameter of 3-4 mm. The pelvis of the kidney was distended by injecting fluid through the catheter so as to force the valve back against the catheter and then the latter was repeatedly partially withdrawn and pushed back with the hope that the spindle enlargement, which could be felt to "hitch" over the obstruction, would destroy the efficiency of this ob-

struction (valve). This was tried on four different occasions, at intervals of two or three days. After this treatment I felt encouraged for the valve was apparently no longer efficient as fluid would escape, in time, from the catheter after the latter was partially withdrawn, showing that the fluid could escape (though slowly) from the distended pelvis of the kidney even when the catheter was not in it.

The treatment on February 17th was more vigorous than usual as I hoped it to be the last one. After the patient returned to the ward she had a severe attack of pain in the right side similar in every way to the previous ones. As this pain did not subside I catheterized the kidney and as the catheter entered the pelvis, blood with clots flowed from the catheter. Two hundred cc. of blood was collected and the patient was immediately relieved. This apparently demonstrated that the valve was probably still efficient for blood had not appeared in the bladder, it having been all retained in the pelvis of the kidney. Apparently the attempts to destroy the efficiency of the valve had failed. The patient remained in the hospital a month longer and while the wax bougies were again tried greater care was exercised in their use in order to prevent any further injury.

In a letter received from the patient, in May, 1907 (over three years after the treatment with the wax dilators), she stated that her general health was excellent and that she had not had any pain since she left the hospital in March, 1904. The efficiency of the valve-like obstruction, at the orifice of the ureter from the renal pelvis, had disappeared and apparently as the result of passing wax dilators to and fro into the pelvis of the kidney, at a time when the valve was most efficient, viz., when the pelvis of the kidney was distended with fluid.

Hutchins, in the article previously mentioned, reports an instance of distension of the pelvis of the kidney without return of the fluid, demonstrating a valve-like occlusion of the pelvis. This observation was made by him in March, 1906.

RESUMÉ.

Ureteral "kinks" may arise from various sources, as an abnormal origin of the ureter from the pelvis of the kidney, blood vessels crossing the ureter, adhesions, etc.

I wish especially to call attention to the part played by the tissue *normally* present about the ureter, in causing these "kinks." As I have previously stated the peristalsis of the ureter tends to convert this tissue into a form of sheath which, as such, may be distinct in one place and less distinct or absent in another. Any interference with the outflow of urine from the lower end of the ureter causes a dilatation of the ureter and its course becomes more tortuous. This tortuosity is but an exaggeration of its natural course brought about by the dilatation of the ureter and the varying amount of interference with its peristalsis from the tissue along its course. This tissue (its sheath) being stronger in some places than in others restricts both the distension and the movements of the ureter at these places while the less resistant tissue, above or below these, permits it to become distended and to curve to either one side or the other. This lateral displacement of the ureter is sometimes so marked as to form a sort of hernia of the ureter through the less resistant tissue (a weak place in its sheath) about it. The tissue which restricts the movements of the ureter in these cases may so kink the ureter as to give rise to a valve-like obstruction which occludes the lumen of the ureter only when the portion above the kink becomes greatly distended. This distension of the ureter may be caused by anything interfering with its outflow.

It is important, therefore, when operating for ureteral obstruction to carefully examine the ureter above, in order to relieve any kinks which may have developed as a result of the obstruction and which otherwise might not be entirely relieved by the operation. There is a natural constriction of the ureter at the pelvic brim due to the tissues about it, and also to its change in direction, as it dips into the pelvis. There is at this place, therefore, a condition present which predisposes to the location of a kink, as occurred in the first case reported.

Valve-like ureteral kinks from any source or of any location may be detected by the renal catheter in the following manner. If the end of the catheter is passed beyond the kink, and sterile fluid is injected through the catheter, distending

the ureter and renal pelvis above, the patient will complain of pain (artificial renal colic) and on removing the rubber bulb or syringe from the end of the catheter, but leaving the catheter in place, the fluid injected into the pelvis of the kidney will escape from the catheter and usually with relief from the pain or discomfort. On the other hand if, after distending the pelvis of the kidney with the fluid, the catheter is slowly withdrawn, the fluid will escape until the eye of the catheter has passed the kink and then the flow will cease and the patient will not be relieved. If more fluid is now injected through the catheter the symptoms are intensified and still it will not return unless the catheter can be pushed further up into the ureter so that the eye is situated above the kink when the distended renal pelvis or renal pelvis and ureter above the kink (as the case may be) will be able to expel the fluid through the catheter.

A spindle or "olive" enlargement of wax may be made just above or below the eye of the catheter and as an "olive-tipped" bougie it may be felt to "hitch" over the kink and so aid in its diagnosis and localization. These bougies may also be used as dilators.

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THE CONSERVATIVE SURGICAL TREATMENT OF THE HYPERTROPHY OF THE PROSTATE GLAND IN THE VERY FEEBLE AND AGED.*

BY JOHN E. SUMMERS, JR., M.D.,
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It has seemed to me that too many experienced surgeons were minimizing the dangers of prostatectomy and in this way creating a tendency among the relatively inexperienced, to underestimate the seriousness of the procedure. More especially is this so when the sufferers are very feeble and aged, and nearly worn out by pain, unrest and hemorrhage.

A little late for many, but fortunate for those who could profit, Dr. Charles H. Chetwood, of New York, published a paper in the *ANNALS OF SURGERY*, October, 1906, directing particular attention to "Prostatectomy in two Stages," a most excellent and instructive contribution. He refers to a special class, viz., the feeble and aged suffering from prostatism and its several complications.

There is nothing new in Dr. Chetwood's paper; others years ago, in practice, have recognized the value of this procedure in the surgery of the prostate, yet no one so far as I am informed has so directly and so well forced our attention to this "Conservative Operation with Minimum Hazard."

Early in my experience in the surgery of the prostate, I was impressed with the value of conservatism. Some seventeen years ago, a valued citizen of Omaha, much weakened and depressed by the pain and hemorrhage from an enlarged prostate, was subjected to a supra-pubic prostatectomy (the McGill operation). I acted as first assistant, and the operator, coming from a long distance, was one of America's most distinguished genito-urinary surgeons, and at the time the most

* Read before the Iowa State Medical Society, Cedar Rapids, Iowa, May 15, 1907.

experienced American operator in the surgery of the prostate. My judgment expressed then was to "drain first"; but of course as my experience in the surgery of the prostate was so very limited, it was given scant attention—in fact, I did not then know how valuable the suggestion was. The patient died at the end of a week from a septic pneumonia. From time to time, I did this supra-pubic operation with varying success. As time went on, the technique of the supra-pubic operation improved; as it did so the mortality diminished, until to-day it is a very safe procedure.

The Bottini and Chetwood galvanic-cautery operations certainly have their place when patients are in a weakened state.

"Each case has its own personal equation, comprehending the important features bearing upon it. Amongst these features of accepted importance we may cite the age and general vitality of the patient. It stands to reason that other things being equal, statistics confined to patients seventy or eighty years old should show a relatively high degree of mortality. Again, the kidneys bear so important a relation to the immediate condition and future outlook of every prostatic about to be operated upon, that the greater the damage already to these organs the less can they be expected to withstand any additional strain consequent upon operation.

"If we sum up briefly the dangers and difficulties to be contended with in prostatic operations, as urinary suppression, secondary shock, and general toxemia, and in especially congested prostates—profuse hæmorrhage, the mortality rate or hazard should bear a more or less direct relation to the existence of these features in any given case" (Chetwood).

Commencing about four years ago, after I had learned to do a perineal prostatectomy properly, I began occasionally in bad cases, to separate the operative procedure into first, a preliminary supra-pubic cystotomy: and later, one week or maybe one month, to remove the prostate through a perineal wound. My reasons for following this sequence may be summarized in this way:

Preliminary supra-pubic cystotomy is preferable to preliminary perineal cystotomy.

First.—It allows of a more thorough examination of the bladder for stone or other complications. As an illustration: An elderly gentleman, a sufferer from prostatism, had his prostate and bladder explored by means of a perineal urethrotomy. The operators were competent; as evidence, one was an ex-president, the other later, president of the American Genito-Urinary Association. These gentlemen decided that prostatectomy was inadvisable because of the inflamed condition of the prostate. The man came to Omaha. Shortly after the perineal wound closed, an enormous stone, evidently of years' formation was removed from his bladder by supra-pubic cystotomy. This stone could not have been overlooked had the original exploration been by the supra-pubic route.

Second.—It allows of a more peaceful drainage: there being less irritability than from the presence of a perineal drainage tube.

Third.—A properly performed supra-pubic cystotomy, if partly closed after the method of Gibson, making a valvular fistula, admits of drainage and irrigation without discomfort, allows of change of position in bed, even getting up early; thus lessening the dangers of hypostatic pneumonia, and bettering the appetite and digestion.

If the patient for any good reason, either upon his part or upon your own, decides not to go farther, you have done the best that the circumstances admitted of.

Perineal drainage under such circumstances will be impracticable.

The prostatectomy may be either supra-pubic or perineal: It is a matter of choice in the experience of the individual operator. My preference is for the perineal route, but I must confess I am beginning to waver, but only a little. As to the choice of methods of the perineal prostatectomy in all patients who have been previously drained supra-pubically, I have strong opinions. First, if the prostatectomy is done soon after the supra-pubic cystotomy, any method may be pursued, but if

there is an old supra-pubic wound or scar, of a month or of years existence, then I believe the intra-urethral attack upon the prostate is the better as offering less danger of recto-vesical fistula either resulting immediately, or later from sloughing. The reason is obvious, because the bladder firmly attached to the anterior abdominal wall does not admit of the prostate being drawn as near the surface of the perineum as when no such relation exists. Therefore the separation of the prostate from the rectum and its enucleation is more difficult. In the intra-urethral attack, Bryson's Operation, no such danger usually exists, at least it should not except possibly in malignant disease.

I wish to refer briefly to several from among my cases, which I have chosen in illustration of what has been said.

CASE I.—Mr. J. M. S., 66, widower, Papillion, Neb.; admitted to hospital May 30, 1905. Urine draining through a supra-pubic opening made by me two years previously, as a preliminary to a supra-pubic prostatectomy—the latter temporarily refused. Pain, loss of sleep, and hemorrhage had finally determined the man to seek relief through a further operation. Temperature, 99.8° F.; pulse, 80. Urinary examination demonstrated a chronic interstitial nephritis. Urotropin and sandal wood oil were given; copious draughts of water were insisted upon. The patient was kept under this preparatory treatment for five days, during which time the temperature and pulse varied from normal to 101.8° F. and 96, respectively.

A perineal section (Murphy type) was made June 5th, and the prostate removed. The temperature and pulse were normal the second and third days following the operation. From the fourth to the eighth days the temperature and pulse rose and fell irregularly, varying from 98.4° F. to 102° F., and from 76 to 102. From the eighth day on, the temperature and pulse remained normal. The patient was discharged July 18th, perineal wound draining feebly; supra-pubic wound closed. Continence with closing of perineal wound soon followed. The patient died one year later from endocarditis, having had very little bladder trouble after leaving the hospital.

CASE II.—Mr. B. S., 76, married, Chadron, Neb. Admitted

to the hospital July 9, 1905, after making a railway journey of four hundred miles. He was very weak and suffered from pain, loss of sleep and hemorrhage. The preliminary treatment was similar to that of Case I, with the addition of strychnin hypodermically, and was continued for four days, the temperature and pulse varying from 98.4° F. to 99.6° F., and from 70 to 86. July 13th, the patient having recovered from the effects of the journey, the prostate was removed through a perineal incision (Proust's operation). For eight days following the operation the temperature varied from 99.8° F. to 102° F., being usually 100.5° F. to 101° F., while the pulse during that time was proportionately lower, never being above 100, usually 86. The temperature became lower, ranging from 98.4° F. to 100.4° F., while the pulse went up steadily. The patient died July 27th.

I have thought that had I done a preliminary supra-pubic cystotomy, the final end might have been long postponed.

CASE III.—A. C. B., 78, widower, Omaha. For past twenty years or more the patient had used a catheter, gradually using it more often. May 29, 1906, the patient found that he could not succeed with the catheter and called a near-by physician who found it necessary to use a metal catheter many times during the two days following. June 1st, after much difficulty, the physician discontinued trying to pass the catheter, as he encountered considerable bleeding and the patient had grown weak; the patient was sent to the hospital. A supra-pubic cystotomy was done at eight P.M., June 1st. The bladder drained well for three weeks, the pulse and temperature going up and down irregularly the first two weeks, but gradually becoming regular. There was great difficulty in getting the bowels to move because of the large irritable prostate.

June 3rd, perineal section was made, and the prostate removed (Bryson's operation). The temperature and pulse varied irregularly from 98.8° F. to 102.4° F. and from 86 to 116. The patient developed a periurethral abscess. This was opened July 15th, and drained, from which time recovery gradually followed.

At present he gets up two or three times a night to void—can retain urine five hours—and voids about the same number of times during the day.

Patient's general condition is very good at this date.

CASE IV.—A stout, but fairly rugged Italian, age 83, resident

of Omaha, had used the catheter for many years, but recently had had several attacks of retention. He was brought to the hospital June 15, 1906, by his physician, Dr. Womersley, who finally in the last attack was unable to relieve him. I did a supra-pubic cystotomy (Gibson). An enormous hydrocele on the right side was the source of great annoyance. On the eighth day after the cystotomy, I did a radical operation for the cure of the hydrocele and also removed the prostate by perineal section (Bryson's operation). The patient could not be controlled; he was up and out of bed the first day after the operation, and nearly every day thereafter. He remained in the hospital six weeks. A recent report from the old man says that he is in splendid condition. It was impossible to give him quieting medicine of any kind, he would not allow a hypodermic injection; he would not take pills or capsules; and would only take liquids after insisting that the nurse swallow some first.

All of these cases had large prostates, and represented the type of "bad risks" which, in my judgment, demand conservative surgical treatment. In common with others, I have had numerous brilliant successes following immediate complete operations in this and other fields, but too often a failure has occurred which might have been averted by a two-stage operation.

EPITHELIOMA OF THE PENIS. AN ANALYSIS OF ONE HUNDRED CASES.

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THIS paper is based on a study of 100 unselected cases of epithelioma of the penis. Of this number 93 were taken from the records of the Massachusetts General Hospital during the 33 years from January, 1872, to January, 1905;¹ the remaining 7 were gathered from private sources.²

This investigation was undertaken:

1. To see what end results have been obtained after operation.
2. To present what clinical facts have been observed in a study of so large a number of cases.

Accordingly the hospital and private records have been thoroughly analyzed, and each case has been followed as far as existing clues would permit. This has involved the searching of state and town records, personal interviews, and a profuse correspondence with the patients, their relatives, and local authorities. As a result 90 per cent. of the cases have been traced to a definite end. When it is stated that just 50 per cent. of this series were operated on previous to 15 years ago, and that nearly 25 per cent. were seen prior to 25 years ago, the results of this search are not discouraging. This paper is unique, in that never before, so far as I know, have as many as 100 cases been so critically examined, and followed to their end results.

¹ My hearty thanks are due to the surgeons of the Hospital Staff, past and present, for permission to use these cases.

² I am deeply grateful to Drs. F. G. Balch, H. H. A. Beach, W. A. Brooks, F. B. Harrington, Horace E. Marion, J. C. Munro, and M. H. Richardson for the use of cases from their private records.

ETIOLOGY.

(a) Contributing causes.

Frequency.—As already noted 93 of these cases embrace 33 years of the existence of the Massachusetts General Hospital, giving an average of only about 2.8 cases yearly. Taken in decades these cases are found to have been seen at the hospital with increasing frequency as the following figures show: 1872–1882, 21 cases; 2.1 cases yearly. 1882–1892, 29 cases; 2.9 cases yearly. 1892–1902, 30 cases; 3.0 cases yearly. 1902–1905, 13 cases; 4.25 cases yearly. Total, 93 cases.

A search for additional cases to complete my series of 100, disclosed the fact that many surgeons of large experience had had no case of cancer of the penis in their practice.

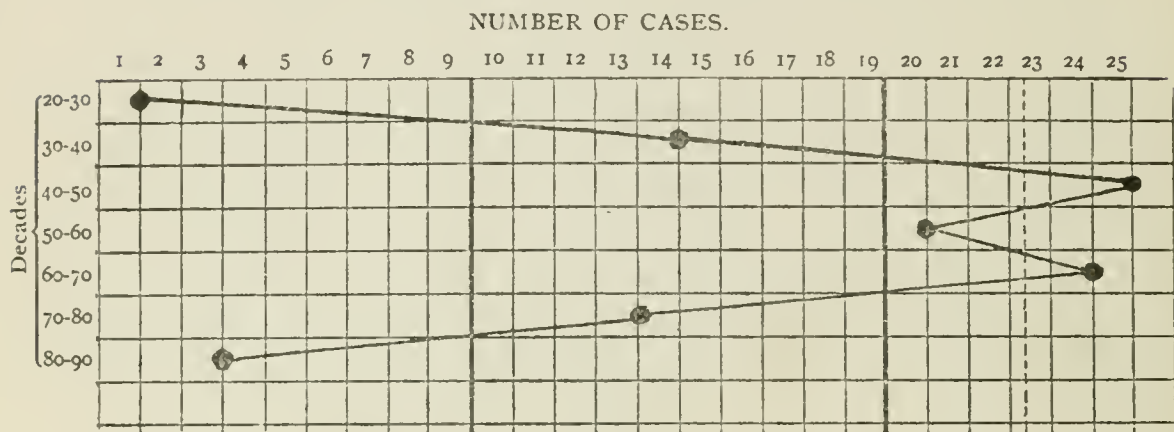
Andrews, in 7881 cases of primary cancer in all regions, saw only 62 of cancer of the penis, or 1.27. Paget states that it forms but 1 per cent. of all cancers, Von Winiwarter 2.5 per cent., while Billroth puts it at 3 per cent. Sawtelle in the United States Marine Reports for the 5 years ending June, 1891, saw but 7 cases out of 70,826 cases treated. Cancerous disease of the penis is therefore rare.

Age.—In this series the two extremes of age during which cancer may occur were illustrated by a man of 25 years on the one hand, and a man of 82 years on the other. A search of the literature reveals a case of carcinoma of the penis occurring in a child of two years reported by Creite (I quote this statement simply on its own merits. Undoubtedly the interpretation of the term “carcinoma” used by Creite differs widely from that used by the majority of pathologists). Curtis mentions a case of Weir’s occurring at 18 years of age. Kaufmann, from an analysis of 227 cases, states that it is most common in the 6th decade, and after that in the 5th and 7th. In 3 out of 130 cases he found the age to be between 21 and 30 years. Demarquay, in 134 cases, saw 9 between 20 and 30 years of age. He quotes Ricord on the other hand, as saying that he never saw a case under 40 years of age.

Taken by decades these cases are as follows: 20–30 years,

1 case; 30-40 years, 14 cases; 40-50 years, 25 cases; 50-60 years, 20 cases; 60-70 years, 24 cases; 70-80 years, 13 cases; 80-90 years, 3 cases. Total cases, 100.

Graphically presented this gives a rather interesting curve:



The average age was 56.02 years.

Civil State.—Of these 100 cases, 85 were, or had been married, while only 11 were single. The state of the remaining 4 was not recorded. In a measure this fact is of little importance, as most men by the time they reach middle life have married. But as almost every treatise on cancer of the penis states that the disease may be the result of contact with a cancerous cervix, I give these figures so that inferences may be drawn.

Contact with Cancerous Cervix.—In this series there was not even a suggestion of this being an etiological factor. Demarquay cites one case which seems to have been acquired in this way. He also quotes examples of cancer of the cervix where coitus had taken place over a long period of time with no implantation on the penis. Martin quotes McFarland, who searched the literature most thoroughly, and found eight cases which, as far as anyone could tell, were undoubtedly due to contact with a cancerous cervix. Bruce cites the case of a man of 58, whose wife died of cancer of the uterus of many years' duration. The man developed a cancer on his penis during the year following her death.

Occupation.—The question of occupation is of no great

importance. Almost every trade or profession has its representative as follows: Laborers 16, carpenters 10, shoemakers 7, farmers 7, machinists 5, merchants 4, sailors 3, butchers 3, clerks 3, printers 2, grocers 2. Total, 62.

The remaining 38 cases all followed as many different callings. The large number of laborers is of little significance as hospital patients are drawn largely from the laboring classes, and the fact that the disease occurs in so many different sorts of workers is sufficient to throw out occupation as a contributing factor. The fact that it occurs mostly in those who do hard manual work might lead one to suppose that trauma played its part. In the records of these 100 cases, only 13 had been questioned particularly on this point. Of these 13, only 3 recalled having any injury to the penis.

Nationality.—The nationalities of these cases are as follows: Americans 53, Irish 25, English 16, Germans 3, Italians 1, unknown 2. Total, 100.

It is worthy of note that the Jewish race does not figure in this list of nations. This is all the more notable when we consider that these people contribute generously to the files of almost every other disease. But is it only a coincidence that a race whose men have been circumcised from time immemorial does not appear in this series?

Other writers (Travers, Patterson) have also noted the immunity of the Jew from this disease. It is also curious that this series includes no negro. I have found no mention of the fact that the negro is exempt from cancer of the penis, and I have no explanation to offer for it. In a search of the literature I find but one case occurring in a negro. I do not mean to say that this disease is rare in the negro. His absence from this series is perhaps explained by the fact that in these parts negroes form a small percentage of all cases.

Heredity.—This, as in cancer elsewhere, seems to play little or no part in the etiology, as in this series only 1 case had a family history of cancer, but that curiously enough was of the penis in the man's father.

(b) Immediate causes.

The term "immediate" causes is somewhat ambitious perhaps, for cancer of the penis, like all other cancer, arises still without known cause. Under this heading however I have grouped those clinical facts which seem to me to have the most important bearing on the origin of the lesion. They are arranged in order of importance.

Phimosis.—This condition is conceded by practically all writers to be the most important factor in cancer of the penis. In this series note was made of the presence or absence of this condition in but 42 cases. Of these it was absent in 6, present in 36, or over 85 per cent. In most of the 36 the patient said he "was never able to retract his foreskin," a fact which would indicate a congenital phimosis, or one of many years duration. My findings are in accord with those of Demarquay, who noted phimosis in 42 out of 59 cases. When we consider that a phimotic condition causes a retention of smegma, or of a few drops of urine, both of which rapidly decompose, and that as a result of this ever-renewed condition the glans and foreskin are constantly bathed in a foul, acrid discharge, it is not surprising that the soil is fertile for malignant as well as for benign growths. In fact Kaufmann goes so far as to say that in elderly men with phimosis, and a foul discharge under the prepuce, the possibility of cancer should always be born in mind, even without the presence of induration. Furthermore this chronic balanitis is frequently associated with the so-called "venereal wart," and according to Kaufmann 29 out of 33 cases of cancer of the penis collected by him began with what were apparently these simple vegetations. The observations of other writers are similar to this.

Here again I must lay special stress on the fact that a large number of these cases had phimosis with its concomitants, and that not a single circumcised Jew was found in the 100 cases. This seems to my mind a most convincing argument in favor of circumcision, in all those cases where the prepuce cannot be easily and completely retracted.

Venereal Disease.—The number of cases in this series in whom the history of previous venereal disease was sought for

was 49. Of these, 22 acknowledged it, while 27 denied it. Unfortunately the records stated in only a few instances whether the venereal disease was in the form of gonorrhœa, chancroids, or syphilis. Two cases however gave a definite history of a specific lesion on the penis, and stated with certainty that the cancerous process had begun on the site of the chancre.

CASE I.—Age 69 years, married, hotelkeeper. Entered Dr. C. B. Porter's service in November, 1894. Contracted syphilis 35 years before entrance. Two and a half years previous to entrance he noticed a little ulcer on the prepuce in front of the corona, on the site of the chancre. Says he has had three or four similar ulcerations on the same place lasting a few days during the past 25 years. This last ulcer continued steadily in spite of treatment. Examination showed a large, hard, ulcerating mass in the prepuce and on the glans. The growth has ulcerated so that there is a large cavity mostly in the dorsum and left side of the penis. Glands in both groins enlarged.

CASE II.—Age 46 years, married, moulder. Entered the service of the late Dr. John Homans in May, 1886. Twenty-two years before entrance he contracted a sore on the penis. The sore was cauterized. In the fall of 1885 a red bunch appeared in the scar, and this has been cauterized many times since because of its increase in size. Examination showed the glans penis to be nearly destroyed by epithelial growth.

My findings are substantiated by those of Cripps, who reports 1 case in which epithelioma developed in the scar of a syphilitic ulcer, and by Martin who cites a case developing in the scar of a chancre 9 years after the appearance of the initial lesion. Still another case is reported by Sibley of a man of 35 who had a chancre. This was entirely healed under specific treatment. When 62 years old a slight redness developed on the site of the chancre. This went on to ulceration and at the age of 69 years the man died of cancer. Demarquay places syphilis second in order of importance of the contributing factors, and records 10 cases of it out of a series of 59.

It will thus be seen that venereal disease, especially syphilis, undoubtedly plays a part in the etiology. I have found no

case that could definitely trace its origin to a chancroid, nor have I seen any mention of the subject in the literature.

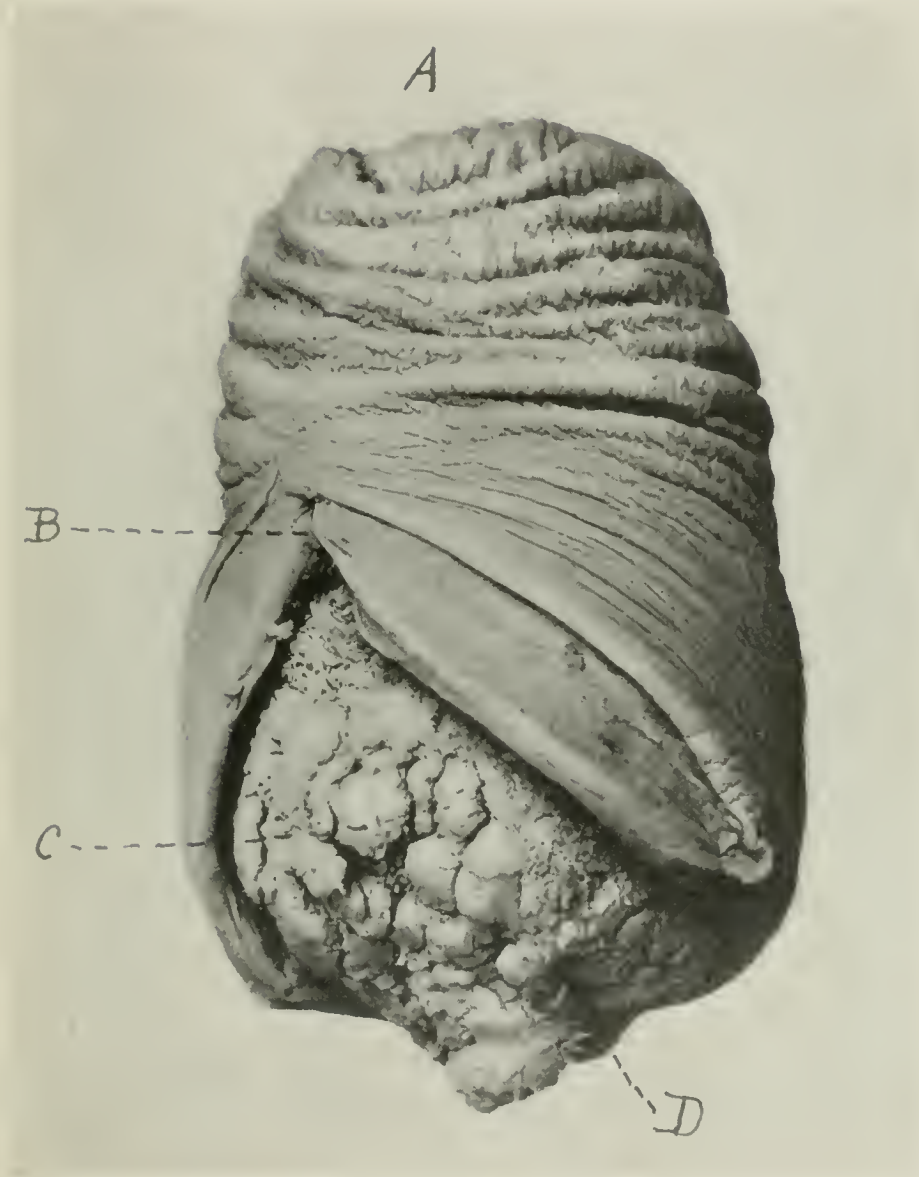
Trauma.—Only 13 of these 100 cases were questioned in regard to trauma. Three only, had had any definite injury. There were, however, 6 cases who had had previous circumcision for one reason or another, and who said that the wound of this operation had either never healed, or that the cancer had first begun in its edges. This surely is a form of trauma, and in these cases it was apparently the beginning of the trouble. We are forced therefore to give some value to trauma as an exciting cause of cancer.

CLINICAL COURSE OF THE DISEASE.

Character of the Growth.—There are according to all writers (more especially Jacobson) two types of growth, the cauliflower or proliferating, and the ulcerating, with indurated edges and rapidly destructive properties. Clinically it is frequently impossible to differentiate these two types on account of their mixed character, especially to be seen in those of long duration. This classification has been still more difficult to make from the imperfect records alone. In doing this many doubtful cases have been excluded. The rest arrange themselves as follows: Cauliflower-like growth, 46 cases (Fig. 1); ulcerative growth, 35 cases (Fig. 2). It is thus seen that the cauliflower growth is the commoner of the two. Thomson also takes this view.

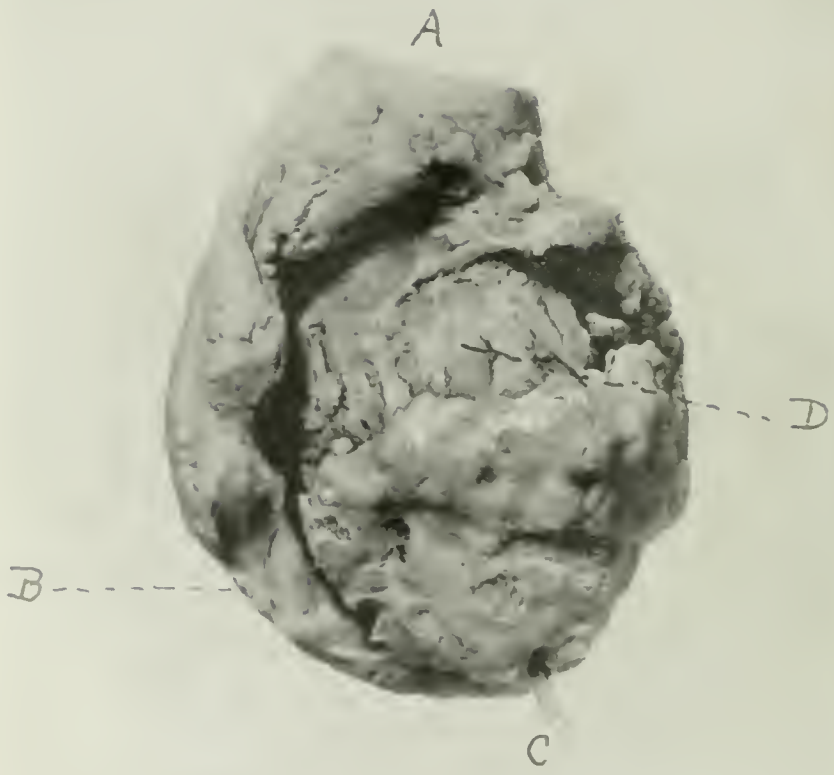
Condition of the Growth.—Inquiry as to whether the growth was ulcerated shows that in 77 cases where the fact was recorded, 65 were ulcerated, and 12 were not. From this it is readily seen that the cauliflower growth goes on to ulceration. It is scarcely necessary to say that all those cases which were ulcerated had a foul, sanguino-purulent discharge, but the large cauliflower growths were also bathed in a creamy, acrid secretion. A few cases gave a history of frequent hemorrhages from the growth, some being a mere capillary ooze, others being an affair of some severity from erosion of the erectile tissue.

FIG. 1.



Cauliflower growth, involving glans (C). Amputated extremity of penis at A, dorsal incision through prepuce at B. Meatus at D. Specimen from Warren Museum.

FIG. 2.



Ulcerative type of growth involving glans and prepuce (D). Amputated extremity of penis at A, edge of prepuce at B, meatus with bougie inserted at C. Specimen from Warren Museum.

FIG. 3.



Cancerous growth of both proliferative and ulcerative type involving glans and prepuce, but most especially the latter. Prepuce, A; glans, B; meatus distended by straw, C. Specimen from Warren Museum.

FIG. 4.



Growth of cauliflower type involving both glans and prepuce, but more especially the glans. Patient 52 years old, duration 2 years; urination through several fistulous openings in growth, small glands in groins. Amputation at pubes, both groins dissected. Death from apoplexy a few years later. Case of the late Dr. John Homans.

Starting-place of the Growth.—Demarquay says that these lesions start most frequently on the glans penis, while Thomson not only agrees to this, but localizes the growth to the dorsal aspect of the glans near the corona. He puts the preputial reflection next in order of frequency. Kaufmann, an indisputable authority, says that out of 33 cases he observed the growth 20 times on the prepuce, and 13 times on the glans.

My observations show that in 65 cases, where there was any definite statement on this point 45, or over 69 per cent., had started on the glans, while 24 had their origin on the prepuce (in its mucous membrane). Many had started in the sulcus behind the corona glandis, while others had started near the frenum at its junction with the glans. In a few cases the growth was still limited to its point of origin, but in most it had spread so as to involve both glans and prepuce (Figs. 3 and 4).

Urinary Symptoms.—It is quite reasonable to suppose that a malignant growth in the region of the meatus and the urethra should cause some urinary symptoms. As a matter of fact such symptoms were present in a majority of the cases in this series who were questioned on the subject. In 39 information on this point was obtained; in 22 there was a story of some abnormality of micturition; in 17 no trouble existed. These urinary difficulties included complete retention (only however in 1 or 2 cases where previous amputation had been done), frequency, burning, small stream, incontinence, and urination through fistulæ in the growth. Many, if not most of the symptoms, were undoubtedly caused solely by the disease, but some of them, such as retention, frequency, small stream, and incontinence might perfectly well have been due to prostatic hypertrophy (which doubtless was present in as large a per cent. of the men of this series as in any similar number of men of this age) or to stricture of the urethra. According to Demarquay retention of urine is not infrequent in cancer of the penis, but where the anterior urethra alone is affected, urinary fistulæ are established, whereby urine may escape. In none of these cases had the lesion begun in the urethra or even at the meatus, so that the urethral occlusion when it existed was due

to extension of the growth, to œdema of the parts, or to the contraction of scar tissue. In regard to this point Keyes says:

"Locally the growth may spread over quite a large superficial area without involving the corpora cavernosa, whose sheaths stoutly resist invasion, while it has frequently been noted that, though the entire glans may be involved in the disease, the corpus spongiosum is usually spared, and urination unimpeded. If, however, the canal does become obstructed the urine usually manages to find its way through one or more fistulous openings in the floor of the urethra."

I would say that urinary symptoms are practically all seen only in the later stages of the disease, when the growth has invaded the body of the penis and distorted the urethra.

The subsequent divisions of this subject will consider the cases in two groups, primary and recurrent. The former had never had a previous operation for cancer of the penis; of the latter all had been operated on once, some of them several times for the removal of the disease.

There were 74 primary cases, and 26 recurrent cases.

Duration.—In patients of the class which makes up the largest part of this series, accurate observation is rare. Furthermore in this disease which begins so gradually, so painlessly, and so entirely lacking in initial symptoms, there is room for much error as to the time of onset. I would further emphasize the difficulties of observing any growth under a congenitally tight prepuce, which many of these patients had, until it has gained very considerable headway. However such figures as have been obtained in regard to the duration of the disease are interesting.

Primary Cases.—Under 1 year, 38 cases; 1–2 years, 18 cases; 2–3 years, 5 cases; 3–4 years, 3 cases, 4–5 years, 2 cases; over 5 years, 4 cases; unknown, 4 cases. Total, 74 cases.

Recurrent Cases.—The figures of these cases are very similar to those of the primary cases, the time in both applying to the duration from the first symptom to the final operation recorded. Several cases had had more than one recurrence, to remove which attempts had been made at successive operations.

Under 1 year, 4 cases; 1-2 years, 7 cases; 2-3 years, 6 cases; 3-4 years, 1 case; 4-5 years, 1 case; over 5 years, 6 cases; unknown, 1 case. Total, 26 cases.

It is to be seen that in either column the figures tend to taper toward the middle, indicating either a very rapid or a very slow growth.

I wish to call attention especially to the important fact that while most cases have a duration of one, two, or three years, yet there is in this series a total of 4 cases with a duration of from 3 to 4 years, 3 cases with a duration of from 4 to 5 years, and most striking of all, a total of 11 cases of over 5 years duration. Many of these latter had existed for a very much longer time than 5 years.

The disease is therefore one whose duration is most uncertain, and in any given case it is practically impossible to say what the outcome is to be.

Another point of interest is that the two types of growth previously described have a different duration. Analysis shows the cauliflower-like growths to have had an existence of about 24 months, while that of the ulcerative type was only 16 months.

Pain.—Unfortunately the question of pain was considered in but 48 of these cases. In 21, or 43.5 per cent. pain was present, in 27, or 56.5 per cent., it was absent. Considered under the headings of primary and recurrent cases the figures are as follows: *Primary Cases.*—Present 16, or 44.5 per cent. Absent 20, 55.5 per cent. Total, 36. *Recurrent Cases.*—Present 5, 41.5 per cent. Absent 7, 58.5 per cent. Total, 12.

These figures although only approximate for each group of cases show a striking similarity, and it is to be noted that in each group pain was absent in a majority of the cases. It is therefore not a constant symptom, and in no case was it evident that it had been severe enough to cause much suffering. The pain was also not especially characteristic. In most instances it was sharp and darting, and was localized chiefly to the penis in the region of the growth. In other cases it was described as being felt mostly in the groins, testicles, or legs, and was of

a dull, dragging character. It was also noted that the pain of whatever character or intensity was one of the late symptoms, appearing in many only after the growth had existed for several years. This feature is best shown by the fact that the percentage of those having pain was even less in the recurrent, than in the primary cases.

Lost of Weight.—Information on this point was obtained in only 14 cases as follows:

Primary Cases.—Present 7, or 100 per cent. Absent 0. Total, 7.

Recurrent Cases.—Present 2, or 28.5 per cent. Absent 5, or 71.5 per cent. Total, 7.

The figures are too small in each group to be of much value, but such as they are it is interesting to see that a total of 9 had definitely lost weight. Of these, 7 were primary cases. In other words, loss of weight had occurred in every primary case where the fact was known. Five cases, all in the recurrent group, had not lost weight, a fact which is contrary to every expectation. "*Ubi gentium sumus.*"

Glandular Involvement.—In 66 cases note was made of the condition of the inguinal glands. They were pathologically enlarged in 50 cases or over 75 per cent., while in 16 no enlargement could be made out. The enlargement was mostly unilateral, and as a rule the glands were enlarged on the same side which the primary growth was on, but in not a few cases they were involved on the side opposite the lesion. This is explained by Keyes who says:

"The lymphatics of the penis so anastomose that a so-called cross-bubo, the sore on the one side of the penis, and the bubo in the opposite groin, occurs not infrequently."

It is well known that the disease is often slow in reaching the inguinal glands, and also that after reaching them it is as often equally slow in spreading further. In a case reported by Taylor the penis was amputated without removing the glands after the tumor had existed for 6 years, and the patient stayed well for 10 years more. That the glandular enlargement may be due to pyogenic, as well as to cancerous infection,

is shown by the fact that out of 20 cases in which the glands were dissected out, and in which there was a definite pathological report, 8 or 40 per cent. showed only simple hyperplasia due to absorption from the ulcerated and infected growth on the penis. The remaining 12, or 60 per cent., proved cancerous. Furthermore in several cases presenting glandular enlargement, where only amputation of the penis was done, the post-operative record showed that there was a marked diminution in the size of the glands. This was evidently due to the removal of the infected focus, but of course does not show that there was no malignant infection as well.

Practically all writers agree that invasion of the inguinal glands is more frequent than is generally supposed. In 48 cases examined by Kaufmann the inguinal glands were found to be free from cancer in only eight. Martin quotes Gussenbauer, who says that the inguinal glands are with few exceptions involved very early, and that even though not palpable, the microscope generally shows cancerous metastasis. In 48 cases examined he found the glands to be involved in 40, of which 30 were bilateral, and 10 unilateral. Kuettner found glandular enlargement in 71 per cent. of 60 cases, but in only 32 per cent. were the glands cancerous. He observed 16 cases with no recurrence after operation, and of these not a single case had glandular involvement at the time of operation.

A point of importance in regard to glandular involvement is that although there may be no demonstrable metastases in the inguinal glands, yet there may be internal metastases. Kuettner speaks particularly of this point. Certain cases in Von Bruns' clinic died of pelvic metastases after amputation of the penis and thorough dissection of the inguinal glands. Being unable to find an explanation of this in the anatomies, Kuettner made a number of injections and found that merely the superficial lymphatics of the penis empty into the inguinal glands, while the deep ones follow the blood-vessels and empty directly into the nodes situated in the pelvis. This is a point of the utmost importance in considering the prognosis. I know

of no way however of predicting this catastrophe, or of diagnosing it antemortem.

Paget said, "The diseased glands are enlarged, hardened, smooth-surfaced, and usually retain their natural connection with the surrounding tissues."

Modern observers go farther than that, for it has been found that in their progress the cancerous inguinal glands may gradually assume a form similar to one of the two types of growth on the penis, the cauliflower-like or the ulcerative. Two cases illustrating this phenomenon have been observed by Taylor. In the first case "the new growth in the glandular structures was very exuberant, and a very large, subcutaneous, lobulated mass was produced which caused ulceration in the skin. Though the superficies of the mass underwent decay its central portions retained their integrity. During its development there was erosion of one or more arteries." In the second case "it seems probable from the history that the cancerous glands underwent acute inflammation, that suppuration ensued, and that they were thus extruded. Around them the malignant action had established itself in the skin, or connective tissue, or both. The morbid process in the first case was quite sharply limited to the glands, with perhaps some secondary skin change, in the second case it began in the glands and destroyed them, then spread to the overlying and surrounding skin."

My findings agree with those of Patterson. He says that the inguinal glands are invaded both by inflammatory and cancer cells. Without operation these glands go on to suppuration, leaving large ulcers which are infiltrated with cancer and as malignant as those on the penis. Because of this double infection operative interference meets with three difficulties:

1. The free communication between the very numerous glands, and their intimate association with important structures.
2. The adherence of the glands to surrounding parts by inflammatory exudate.
3. The softening of the glands by inflammatory products which render their complete extirpation difficult. Small bits of

cancerous gland tissue are left behind, and these act later as foci of recurrence.

In connection with glandular involvement I note for the sake of completeness the

Involvement of the dorsal lymphatics of the penis.

In only 5 cases was the condition of these superficial lymphatics observed, but in all they were like hard, fibrous cords running up to the pubes toward one groin or the other. One of these was a recurrent case, the other four primary cases. In another recurrent case having 4 operations in as many years, a hard fibrous cord was noted running from the metastatic growth in the groin toward the umbilicus. As the lymph stream offers the principal channel by which metastases can occur in cancer, it seems strange that the lymphatics were not noticeably indurated in a greater number of cases. However as in many the entire penis was edematous and indurated as far back as the pubes, it would be easy for any one lymph channel to escape notice. Moreover it has been shown by Kuettner that the deeper lymphatics may be the only ones involved. It must also be remembered that the involvement of the superficial lymphatics may be only microscopical.

Thomson says in regard to this point that one of the 3 methods of backward extension of a cancerous lesion on the penis is by the main lymph channel in the dorsum. Later on however he says that in transverse sections of the penis, in cases in which the disease of the glans was well advanced, he was unable to observe cancerous emboli in the lymphatics, like those demonstrated by Stiles, in the lymphatic vessels running from the breast to the axilla in cases of mammary cancer. In other words Thomson says there was no anatomical explanation, in the specimens studied by him, for the early infection of the inguinal glands.

I would add that as the cancerous growth on the glans is usually infected by pathogenic bacteria, this fact in itself might account for the induration of the lymphatics.

Evidence of Internal Metastases.—Those metastases (beyond the inguinal glands) which were demonstrable at the

time these cases were seen, were all limited to the pelvic organs. In two cases the entire spermatic cord was much enlarged and indurated, especially its inguinal portions. In 5 cases there was unmistakable clinical evidence of cancerous growths in the rectum, prostate, and vesicles, and in one of these cases, the whole perineum was riddled with sinuses and cancerous nodules.

As regards metastases in the abdominal and thoracic organs and the central nervous system, it is said by all writers that such deposits are exceedingly rare. As I have said before no case in this series had such metastases demonstrable when seen.

According to Kaufmann the internal viscera have been seen to be secondarily infected by Von Winiwarter, Ricord, and Louis each in one case, and by Lebert in two cases. Curtis, Kuettner, Wilson, and Kocher each report a case with autopsy, making only 9 cases in all, so far as I have seen in a comparatively scanty literature.

In this series so far as known, one case in the recurrent group, and four cases in the primary group dying of cancer, had internal metastases. In other words, over 15 per cent. (32 of these 100 cases died of cancer) had metastases in the vital organs. This is contrary to the statements of other writers, and we can say that internal metastases are by no means uncommon. Unfortunately I have no knowledge of any autopsy on any of these cases who died of cancer. The diagnoses were clinical, made by the attending physician. In one case a large mass was felt in the region of the gall-bladder.

In the cases reported in the literature metastases took place in the central nervous system, lungs, heart, liver, and stomach.

It is fair to say therefore that death in epithelioma of the penis results usually from general cachexia, induced by inguinal or pelvic metastases, but in over 15 per cent. of cases it is due to invasion of some vital organ.

Implantation of the Growth.—In one case there was a large cancerous ulcer on the scrotum, arising from contact with

it of the lesion on the penis. This, together with the fact that in a large majority of these cases the cancerous process had spread from glans to prepuce, or vice-versa, illustrates the ease with which cancer is implanted on adjacent parts.

PATHOLOGY.

Epithelioma of the penis may begin in one of several ways.

1. As a simple wart. Kaufmann states that in 29 out of 33 cases he saw the disease begin in this way. Nine cases of this series are known to have commenced thus.

2. As a "pimple," in which case it is usually situated near the lymphatics. Nine cases had this origin.

3. As a superficial excoriation or raw patch. There were 4 cases of this.

4. More rarely as a true ulcer. Eight cases started in this way.

5. Very rarely begins in the urethra (*i.e.*, meatus) or spreads to the penis from the scrotum. In 134 cases Demarquay found the urethra involved only twice.

Fifteen of this series said that the trouble began with a hard, smooth "lump" which progressed more or less rapidly to its final form. Two cases noticed first a little "scab" on the glans; two others had their attention first called to the trouble by a sanguino-purulent discharge from under the foreskin.

Thomson has something to say in regard to the existence of precancerous conditions of the epithelium of the penis. It may present one or both of the following changes:

1. A catarrhal condition (balanitis) in which the surface layers are shed, the deeper layers are permeated by leucocyte infiltration, and the subjacent connective tissue shows great increase in vascularity.

2. More frequently a marked thickening of the surface epidermis, along with a rich infiltration of small cells in the subepithelial connective tissue. The overgrowth of surface epidermis may be uniform or papillary, or may present complete branched filiform processes. It ceases abruptly at the edge of

the cancer. These conditions of surface epidermis are similar to those observed in the lip and tongue in association with cancer, and have been described by Schuchardt and others under the name of "psoriasis preputialis."

Epithelioma is practically the only form of cancer attacking the penis. Its microscopic appearance is that of any squamous-cell cancer, and I have nothing further to add in regard to it. As already shown it may assume one of two forms, the cauliflower-like, or the ulcerative. Its manner of growth when attacking the inguinal glands has also been touched upon.

A case of "medullary cancer" of the penis is described macroscopically and microscopically by Kilgarliff, occurring in a man of 55. The duration was four months. Gould reports a case of melanotic epithelioma of the penis occurring in a man of 75 years, with 5 years duration. Both Paget and Billroth described such a growth, but it is evidently an almost unheard-of thing. Medullary cancer of the penis occurs apparently with equal rarity.

MODE OF EXTENSION OF THE DISEASE.

Although I can say nothing from personal observation about this matter, I think it worth while to state that there is still a good deal of uncertainty on this point. So great an authority as Kaufmann could find no evidence of penetration of cancer in the erectile tissue spaces. Thomson takes an opposite view, and mentions a specimen in the Hunterian Museum in London which proves his point. It is undoubtedly true, however, that the stout fibrous sheaths of the corpora cavernosa resist invasion for a very long time, but the late invasion of erectile tissue may be accounted for also by the tendency of the growth to proceed in the line of least resistance, heaping layer upon layer on its surface, forming the cauliflower mass.

The disease extends backwards in one of three ways.

1. By extension along the main lymphatic vessels in the subcutaneous tissue of the dorsum of the penis, and continuous with the primary growth.

2. Penetration (in time) of the erectile tissue by epithelial prolongations, forming continuous cancerous infiltrations of the blood spaces.

3. More rarely by the development of outlying foci, or secondary nodules of cancer in the erectile tissue, perhaps at some distance from the primary growth.

The last two types of the extension of the disease were shown fairly well by the experiments of Kuettner previously mentioned.

The first type shows that amputating the penis by leaving a dorsal flap should be abandoned, for in making the latter the main lymphatic trunks are included.

An examination of many specimens by Thomson shows that as a rule the cancer tends to be localized for a long time to its original site, and that so far as local recurrence is concerned, it should be easy to prevent this by an early amputation. Epithelioma originating in the prepuce itself, shows the least tendency to extend backwards along the body of the penis.

RECURRENT CASES.

As stated above there were 26 recurrent cases in this series. A few had had more than one operation for the removal of the growth. Horteloup says that recurrence usually takes place during the first year after operation, but that it has been seen during the second year. Guyon cites a case occurring after 3 years.

My figures are as follows: Under 1 year, 12 cases or 39 per cent. Some had more than one recurrence. 1-2 years, 6 cases or 19 per cent. Some had more than one recurrence. 2-3 years, 5 cases, or 16 per cent. 3-4 years, 2 cases or 6 per cent. 4-5 years, no cases. Over 5 years, 4 cases or 12 per cent. Unknown, 2 cases. Total, 31 cases.

I wish to call special attention to the fact that in these 26 cases, 2 or over 6 per cent, recurred between 3 and 4 years, and 4 cases or over 12 per cent. recurred over 5 years after operation. These figures offer a striking contrast to the statements of other men.

Region of Recurrence.—Local (i.e., in the penis or its stump), 21 cases; groin alone, 2 cases; local and groin, 3 cases. Total, 26 cases.

Previous Operations.—Amputation alone, 7 cases; amputation with dissection of groins, no cases; circumcision, 13 cases; excision of the growth, 12 cases; dissection of the groin alone, 2 cases. Total, 34 cases.

Thus 34 operations were done on 26 cases. It is to be noted that palliative operations such as circumcision and excision, were by far the most numerous, and that there was no recurrent case having the radical operation of amputation with dissection of the groins.

Final Operations.—Amputation alone, 16 cases; amputation with dissection of groins, 4 cases; dissection of groins, 2 cases; excision by curette or cautery, 3 cases. Total, 25 cases.

One man refused operation and “eloped,” dying over 6 years later of “phthisis.”

In this group it is to be observed that the more radical operations are preponderant.

End Results (of Recurrent Cases).—Living (without recurrence) or cured, 11 cases. 42 per cent.; deaths from cancer, 10 cases, 38.5 per cent.; deaths from other causes, 4 cases; unknown, 1 case. Total, 26 cases.

Living (Without Recurrence) or Cured Cases.—In this group of 11 cases I have put 3 about whom there is a possibility of error, but whom I personally consider as cured. Two cases were seen, one 4 years, and another 8 years after operation by Dr. M. H. Richardson, of Boston, and were found to be perfectly free from any sign of cancer. They both died several years later, one of “cystitis with ascending pyelitis,” and another of “emphysema of the lungs,” and at an advanced age. The third case died 9 years after operation, of “heart disease,” in old age. So far as known there was no recurrence.

Of the other 8 cases, I have either seen or corresponded with 4, and of the rest I have heard from their physician or near relative.

The operations done on those in this group are as follows:

Amputation with dissection of groins, 1 case; amputation alone, 8 cases; excision, 2 cases. Total, 11 cases.

The pathological report on the cases in this group is as follows: Specimen from penis malignant, 10 cases; glands from groin malignant, 1 case. Total, 11 cases.

The average length of life of those in this group (after operation) is about 24 years. One man is alive now, 30 years after operation.

Cases Dying of Cancer.—In these 10 cases recurrence is known to have occurred as follows: Inguinal glands, 2 cases; pelvis (rectum, perineum, etc.), 1 case; internal (liver), 1 case.

The operations done on these 10 cases were as follows: Amputation with dissection of groins, 2 cases; amputation alone, 5 cases; dissection of groins alone, 2 cases; excision (curetting of cancerous nodules in perineum), 1 case.

A pathological report was made in the excised specimens from these cases as follows: Specimen from penis malignant, 7 cases; glands malignant, 3 cases; glands non-malignant, 1 case.

The length of life of these 10 cases from the time of onset of the disease was about 8 years and 3 months.

The length of life after final operation was 4 years and 2 months. Two cases lived only 8 months after: 1 case lived 15 years and 5 months after!

Of the cases dying of other causes there is little to be said, except that there was no death immediately following the operation.

Primary Cases.—The final operations done on these cases were as follows: Amputation, 46 cases; amputation with dissection of groins, 16 cases; excision, 5 cases; circumcision, 2 cases; meatotomy, 1 case; no operation done, 4 cases. Total, 74 cases.

In three of these cases where amputation was done, the scrotum was split, and the urethra planted in the perineum. Total emasculation was done in no case.

The end results of these cases are as follows: Living

(without recurrence) or cured, 27 cases, 36.5 per cent.; deaths from cancer, 22 cases, 29.0 per cent.; deaths from other causes, 15 cases; unknown, 9 cases; living without operation, 1 case. Total, 74 cases.

Living (Without Recurrence) or Cured.—As in the recurrent group, I have included in this list of 27, 13 cases dying of other cause over 5 years after operation, in whom it is reasonably certain that a cure was established. Of these, 2 were seen by Dr. M. H. Richardson at intervals of 7 and 8 years respectively after operation, and were found to be perfectly well. They died many years later, one of pneumonia, and one of old age. The other 11 cases are those who died over 5 years after operation of other causes than cancer, and of diseases which apparently were not due to internal metastases. These diseases include old age, pneumonia, phthisis, and heart, and kidney affections. As it was shown in the analysis of the recurrent cases, that one died of cancer over 15 years after operation, and that 4 cases had recurrence 5 years, or over, after operation, one might say that it is unsafe to consider any cases cured unless proved by autopsy. But my point is that these cases apparently lived a natural life, which was terminated by other cause than cancer.

Most writers on the results of operations for cancer, have set a three-year limit as the time which must elapse without recurrence, before a cure can be said to have been made. Recent careful investigations by others, and the results obtained in this series of cases, forces us to lengthen this limit to at least 5 years. As a matter of fact my observations make me hesitate to set any definite time-limit.

The operations done on these 27 living or cured cases were as follows: Amputation, 20 cases; amputation with dissection of groin, 5 cases; circumcision, 1 case; meatotomy (for stricture in stump of penis which had previously been amputated), 1 case. Total, 27 cases.

One man refused operation and "eloped." He is still alive, although the disease began over 11 years ago.

A pathological report was rendered in these cases as fol-

lows: Specimen from penis malignant, 17 cases; glands from groin malignant, 1 case; glands from groin non-malignant, 3 cases.

Cases Dying of Cancer.—The operations done on these cases were: Amputation with dissection of groin, 5 cases; amputation, 13 cases; excision, 1 case; no operation done, 3 cases. Total, 22 cases.

The pathological report of these cases is as follows; Specimen from penis malignant, 15 cases; glands malignant, 1 case; glands non-malignant, 1 case.

Unfortunately I know about the site of recurrence in but 9 of these cases; Local (*i.e.*, stump of penis), 1 case; inguinal glands, 4 cases; internal (stomach and liver), 4 cases.

The average length of life *after the onset of the disease* was 3 years and 4 months, the shortest being 9 months, the longest 10 years and 5 months.

The average length of life *after operation* was 24 months, the shortest being 2 weeks, the longest 9 years and 3 months.

Here again there is little or nothing to be added about the cases dying of other causes, except that one died of sepsis in the hospital, to be considered, if you please, as an operative mortality of 1 per cent.

OPERATIVE SEQUELÆ.

Demarquay gives the following list of untoward operative sequelæ: 1. Retraction of stump. 2. Retraction of urethral orifice with abscess and fistula of stump. 3. Infection (bacterial) of inguinal glands. 4. Recurrence. 5. Generalization of the affection. 6. Aggravation of poor general condition. 7. Mental changes. 8. Loss of sexual power.

Skill or good fortune averted many of these unpleasant consequences in this series. Two men had had the penis amputated before coming to the hospital. Each had a stricture of the meatus of the stump, and this was divulsed. The urethra of one of these cases was packed full of small, facettèd calculi, and a second amputation was done.

None of the cases that I saw or heard from, laid any stress on the loss of sexual power. In fact many denied such a possi-

bility, and in them it was apparently only a curtailment of their powers. Fortunately this disease and its radical treatment comes at a time when sexual matters are usually not uppermost in the mind.

Some writers, notably Demarquay, say that patients whose penis has been amputated are often seized with profound melancholia, and several suicides from this cause are reported. This depression has been absent, so far as known, from all these cases. On the contrary the tone of their letters, or statements, was one of joy at the new lease of life which the operation had given them. It must be born in mind, however, that the cases on which Demarquay based his observations were of an emotional race, in whom mental instability is not uncommon. The cases composing this series were, as a whole, of an entirely different type.

CONCLUSIONS.

1. Epithelioma is practically the only kind of cancer attacking the penis, and its frequency forms only from 1 per cent to 3 per cent of all cancers.

2. It occurs most frequently during the fifth, sixth, and seventh decades of life.

3. Phimosis is preëminently the most important of its exciting causes, occurring in over 85 per cent. of cases. Circumcision, therefore, cannot be too strongly advised, especially after middle life, in all cases where the prepuce cannot be easily and completely retracted. Syphilis and trauma are to be considered next in importance from an etiological standpoint.

4. Most cases seek relief during the first and second years of the disease, but it is not unusual to see cases of from five to fifteen years duration.

5. Pain occurs in 43.5 per cent. of all cases. It is rarely severe, and usually occurs late in the disease.

6. Enlargement of the inguinal glands occurs in over 75 per cent. of all cases. In 60 per cent. these glands are cancerous. The rest show simple hyperplasia from septic absorption.

Glandular involvement may occur early, but from my

FIG. 5



Showing result of amputation of penis at pubes. Groins not dissected. Meatus lies at bottom of dimple in folds of scrotum. Urination free, urine ejected several inches from body, enabling patient to stand at the ordinary urinal. No recurrence after 12 years. Case of Dr. A. T. Cabot's.

study of these cases I am inclined to regard it rather as of late occurrence.

Inguinal metastases cause death sooner or later. If well advanced, attempts at their removal are to be considered only as "surgical vandalism."

7. Invasion of the vital organs occurs in over 15 per cent. of all cases. It may occur without involving the inguinal glands.

8. Recurrence takes place up to one year after operation in over 39 per cent. of cases, up to two years in over 19 per cent., up to three years in over 16 per cent., up to four years in over 6 per cent., and, most notable of all, it occurs over five years after operation in over 12 per cent. of cases.

Its site depends largely upon the original operation performed, and will be local where only palliative operations have been done. It may occur several times.

9. The operative mortality is 1 per cent. This case died of sepsis, a misfortune which might occur in any operation.

10. The gross mortality is 32 per cent. That of the primary cases is 29 per cent., of the recurrent cases 38.5 per cent.

11. Thirty-eight per cent. of all cases are cured; of these the primary cases form 36.5 per cent., the recurrent cases 42 per cent.

12. Early amputation of the penis at the pubes with thorough dissection of the groins is the operation of choice. If taken in the earliest stages, however, amputation alone may effect a cure. The operations of splitting the scrotum and transplanting the urethra into the perineum, or of total emasculation, offer no greater hope of cure.

13. The length of life from *time of onset* in primary cases is 3 years and 4 months; in recurrent cases it is 8 years and 3 months.

The length of life after *final operation* in primary cases is 24 months; in recurrent cases 4 years and 2 months.

Cases may live for over 11 years after the onset of the disease without operation.

14. Sexual power is not necessarily destroyed by amputation of the penis.

15. Melancholia (in this country at any rate) rarely, if ever, follows the loss of the organ.

16. Amputation, even close to the pubes (Fig. 5), does not necessarily cause any disturbance of micturition.

17. The patient will be confined to the hospital for about 14 days after the radical operation.

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THE "BOTTLE OPERATION" METHOD FOR THE RADICAL CURE OF HYDROCELE.

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Professor of Surgery in the Northwestern University Medical School.

OPEN operations for the radical cure of hydrocele may be classed as of three types:

1. Packing or tamponade of the sac, causing adhesive inflammation.

2. Resection of the sac or portions of it.

3. Eversion or backward suturing of the two halves of the bisected sac.

1. "*Seton*" or *Open Packing*. "Volkmann's Operation." The earliest use of the packing method contemplated or always caused suppuration, as it preceded the antiseptic era. Later, when aseptic methods prevailed, it was found that sterilized gauze packing would bring about the same result, an adhesive inflammation between testicle and sac wall, without micro-organisms. This, to be effective, must go to the extent of causing somewhat intense irritation of the serosa and swelling of the scrotum, disabling the patient for rarely less than two or three weeks. The thickened parietal and visceral layers, while in process of obliteration, cause enough reaction to be somewhat painful and to require recumbent treatment. The method, nevertheless, is a very reliable one.

2. *Excision of Sac Wall*.—It requires less severe reaction—theoretically, none at all—to cause plastic union between one serous surface and the dartos or connective tissue, hence if the outer layer of the hydrocele sac be excised, and the visceral or that covering the testis remain, an excellent cure is obtained quickly. This led me, and no doubt many operators independently, to practice cutting off the two leaves or halves of the bisected sac, so that we have reports of numerous excision operations, usually attended with success.

Practically, excision of the sac is too bloody to be called a neat and rapid method. The bisecting cut along the anterior median line is bloodless, but the lateral cuts, dividing the halves of the serous sac from their junction with the epididymis, cross rarely less than half a dozen vessels, requiring separate ligatures. This, with the staining of the tissues it involves, takes away all the neatness and speed of the operation. The results of this method are satisfactory, if great pains are taken not to leave any fringes of loose sac wall large enough to form new pouches. Hydroceles sometimes recur in a mysterious way from this error, and also from overlooking funicular pouches above the testicle.

3. *Eversion of Sac*.—When Jaboulay's method (sometimes also called Winkelmann's method in Germany) was published, my attention was very favorably called to it, and I have never had anything but encouraging results from its employment, barring one case of recurrence which I cannot explain. I have heard uniformly good reports of it in the hands of Dr. Ferguson and others here. Dr. McArthur alone criticised it as causing too much reaction, swelling and pain. My own cases have showed less soreness and shorter confinement than with any other technique.

The method consists in first bisecting the sac by a vertical incision along its anterior convex surface after isolating the whole mass from the dartos and lifting it outside the scrotal skin. The two flaps or halves thus formed are then everted and brought together back to back behind the globus major and epididymis, so that the whole serous lining faces outward. Anyone not a novice can make this entire dissection so nearly bloodless that the tissues do not become sodden or stained. The two everted flaps are now sutured together behind and all possibility of their reuniting into a closed sac is as effectually prevented as if they had been excised.

4. *Author's Method*.—A new technique which I have used exclusively in the past two and a half years seems to me such an improvement in certainty and speed that I recommend it without reserve, and do not hesitate to urge that it supersede

FIG. 1.



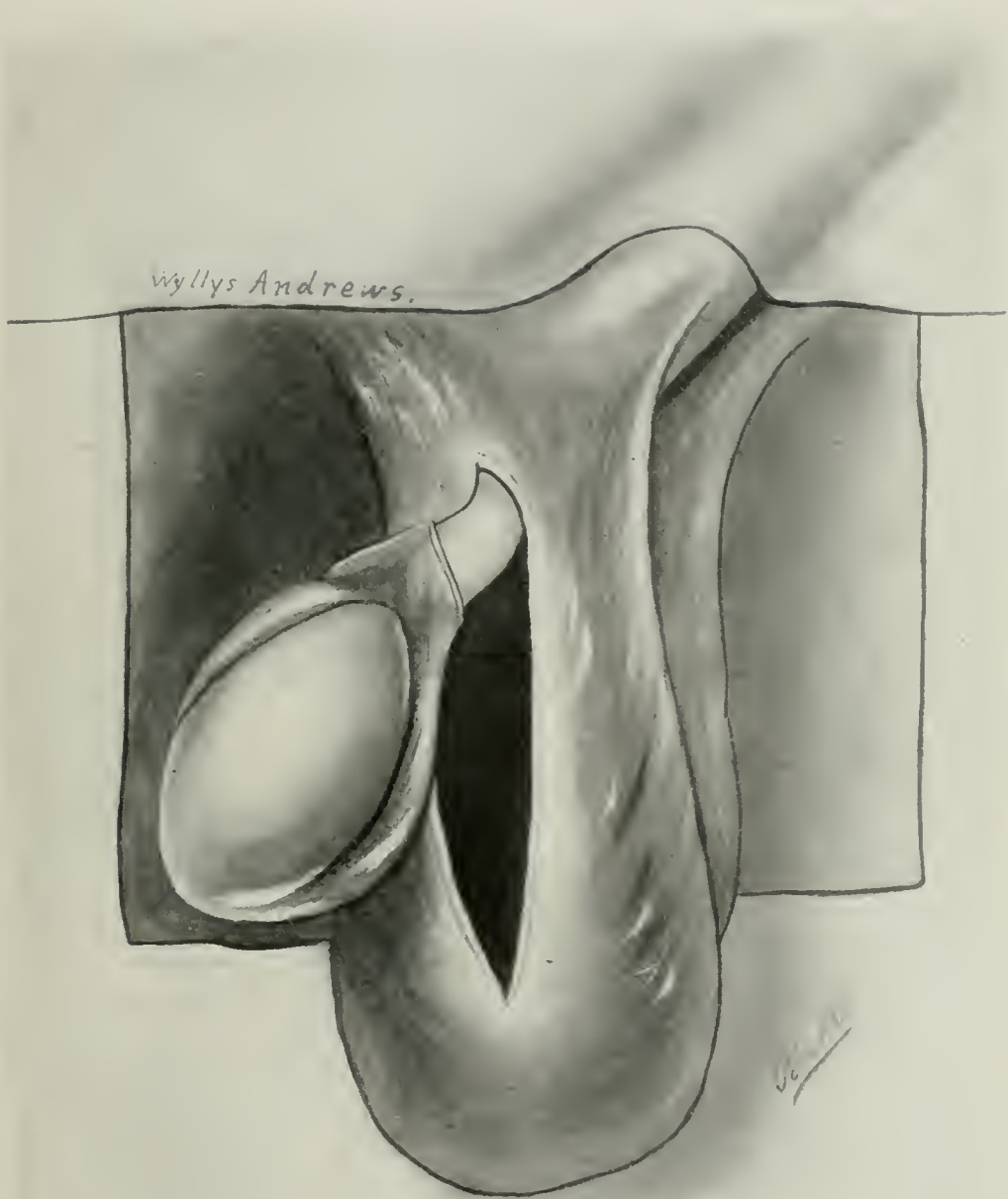
Hydrocele and testis enucleated. Incision at anterior upper portion.

FIG. 2.



Eversion of "bottle" by pushing testis through small hole in upper end.

FIG. 3.



Completely everted sac. The small anterior cut now takes a posterior position around the cord. No sutures required.

the older operations. The method, which I think is described very aptly by the term "bottle operation," brings about a complete eversion of the whole lining, without the use of stitches, and with much less cutting than the Jaboulay method.

TECHNIQUE OF THE "BOTTLE OPERATION."

An anterior scrotal incision is made as in the older methods. The skin should be held tense and the dissection should be nice to the exact layer which will enucleate the translucent bladder-like mass from its bed (Fig. 1). It is not an operation for a man over forty-five to attempt without glasses.

Careful study of the funicular part of the sac is now to be made. Usually a little funnel continues one or two cm. up the cord. The extreme upper end of this marks the beginning of the cut made into the sac. This cut is vertical, on the anterior border, and only about 2 cm. long (Fig. 1). We enlarge it a little by stretching. Sometimes it is wholly confined to the part over the cord. The incision in the sac is prolonged to its extreme upper end along the cord if the first cut did not do this. When the sac has been emptied, it is like a bottle or bag, with a small hole at the top. Dilating this slightly with one or two fingers, the orifice is held open and the testis is pushed up into it with the other hand or the two thumbs (Fig. 2). In a moment it can be squeezed through, and the whole sac will instantly be everted with the small buttonhole so closely surrounding the cord that it is scarcely visible (Fig. 3). The quickness with which this can be done will surprise anyone used to the older methods. It will also be seen at a glance that there is no possibility of the testis returning into the hydrocele cavity any more than with the suture method. The short incision contracts, so as to fit around the cord, and the whole sac by its elasticity seems to collapse around the epididymis with its white serous surface almost as smooth as that of the testis. I have never seen the everted sac voluminous enough to lie in wrinkles or folds, but no harm would result if it were so to act. Ordinarily, the largest hydrocele sacs when collapsed assume about the size of the testis, showing that

their walls remain perfectly elastic. As yet I have not tried my method on any very opaque, hypertrophied or thick-walled hydrocele. It is conceivable that some such old cases resulting from inflammations, injections or former operations, might be difficult to enucleate from the scrotum, or to evert after bringing outside the skin.

The skin is quickly closed with clips or light suture, without drainage. Such wounds heal within a week. The patients get about readily on the third or fourth day, sometimes earlier. The amount of swelling about the testis is usually small, even in double hydroceles. Tenderness and pain are moderate or absent, and no fever and malaise are felt after the second day.

This operation is very suitable for local anæsthesia, and therefore can be done on the aged without risk. Its results are in striking contrast with the old packing or open method, called in Germany Volkmann's method, but really of much older date. Koenig reports that the average confinement with this method was three weeks, and also that some patients were disabled fully as long by injection treatment, which also gives a very large percentage of failures.

No complications have occurred in a considerable series of these operations in our clinic, and, so far as we can learn, no recurrences. The recovery has without exception been rapid and practically painless.

BILATERAL TUBERCULOUS BURSITIS OF THE HIPS.

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OF CALCUTTA, INDIA.

ALTHOUGH tuberculous disease of the bursa over the trochanter major is not uncommon yet for both to be affected at the same time may be considered a rare event; the size and the remarkable symmetry of the two swellings in the case recorded below are also of interest.

R——, aet 8, a Hindu child, District 24 Perganas, was admitted into the Medical College Hospital, Calcutta, on June 3, 1904.

The history obtained was that a year previous to admission, he suffered severely from fever for a month or so; during the course of the fever he suddenly felt pain in the left hip which later became tender and began to swell. Two weeks after the onset of pain in the left hip, the same series of symptoms appeared on the right side. The swelling increased but the pain and tenderness diminished; at the onset of the pain some difficulty was noticed in moving the thighs but this rapidly disappeared.

The swelling on either side gradually increased and for a month or so before admission there was a return of the fever but at this time much less severe in type and characterized by a nocturnal rise. On admission, the boy was sparely built, emaciated and anæmic. Both the hips were seen to be much enlarged and the swellings were to all intents and purposes symmetrical, being somewhat pyriform in shape. Behind the tumor was smooth and globular and extended from the iliac crest above to the gluteal fold below; on the inner side it did not reach beyond the ilio-sacral articulation.

In front the swelling passed downward from the outer half of Poupart's ligament, the inner border being external to the femoral vessels and slanting outwards towards the insertion

of the gluteus maximus. On the anterior aspect the surface was more irregular, producing in places a bossy appearance. On the right side at the lowest point in front the skin was adherent over an area about the size of a half penny and here a hard nodule could be felt; elsewhere on both sides the skin was unaffected.

The swellings were tense and fluctuation could be readily obtained in any direction; the fluid was beneath the gluteus maximus.

Movements of the hips were free and painless in all directions except in extreme flexion when there was some limitation due to the size of the swelling. The gait was waddling and a little lordosis was present. The greatest circumference of the swellings was equal and measured $19\frac{1}{2}$ inches. A slight evening rise of temperature to 100° was present, and the patient was suffering from scabies. After a few days treatment with quinine and iron, operation was performed on the right side. A transverse incision was made extending inwards from the top of the great trochanter for about 4 inches, down to the gluteus maximus and this muscle was separated in the direction of its fibres; a large quantity of pus escaped with some masses of caseous material and many calcareous particles; the general effect being as if a quantity of mortar had been let out. Another smaller incision about $1\frac{1}{2}$ inches long was made below the anterior superior spine; through these incisions the cavity was thoroughly scraped with a sharp spoon and Barker's flushing curette; the irrigating fluid used being hot 1 in 5000 HgCl_2 . The incisions were closed with silkworm gut sutures, a small gauze drain being left in the posterior one. The wound healed by first intention and the general condition improved; there being no further rise of temperature.

Seventeen days later a similar operation was performed on the left side except that the posterior incision was made parallel to the fibres of the gluteus maximus and a third incision behind at the level of the crest of the ileum. The contents of the cavity were also similar.

In both cases the cavity was loculated and irregular; the

FIG. 1.



Bilateral tuberculous bursitis of the hips.

disease having extended a little way between the deeper muscles of the buttock. A careful examination of the great trochanters was made but no bone disease was discovered.

The further progress of the case was uneventful; the wounds healed by first intention, and he left the hospital on July 13. The greatest circumference of the hips then being right 16 inches, left 15 inches.

The photograph (Fig. 1) shows well the condition of affairs before operation. He returned to hospital in September with a small residual abscess on the right side which was treated in the same way; there was no further evidence of disease on the left side.

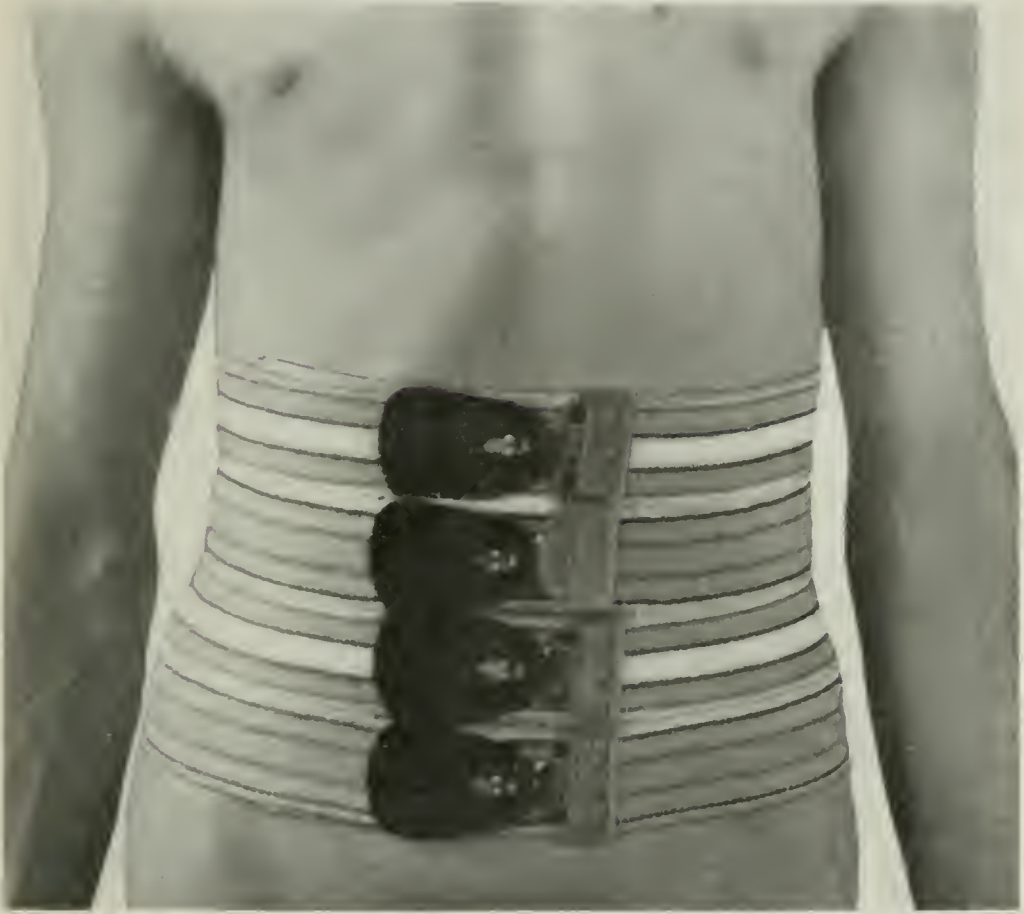
THE "SUSPENDER" ABDOMINAL BANDAGE. THE FOUR-TAILED GENITAL BANDAGE.

BY G. SHEARMAN PETERKIN, M.D.,
OF SEATTLE, WASHINGTON.

FIGS. 1 and 2 represent a bandage that may be employed after an abdominal operation to support the parietes. It is especially adapted to men who have to perform hard, manual labor; is economical, being made from two pair of Shirley suspenders, used by lumbermen (Fig. 3). These are ripped apart, their long borders approximated, and sewed together, the four ends where the buckles are attached being left free, so that they may be tightened or relaxed, that the binder may fit individuals of different sizes, or the same individual at different times. Moreover, it necessitates neither understraps or shoulder straps, as it does not slip up or down, because the lower border of the belt being placed below the anterior superior spines of the ilia embraces the crests and, the lower buckle being drawn more tightly than the remaining three (on the principle of adjusting a corset), the elasticity of the material maintains the belt in position.

Figs. 4 and 5 represent a bandage devised and employed in inflammatory conditions of, or operations on or about the scrotum and testes. Its greatest recommendation is that it is easily made, simple and effective and requires no stitches or pins, as the illustration will readily demonstrate. The material is unbleached muslin. Directions for making are as follows: Length obtained by measuring from anterior superior spine of the ilium to the end of the external malleolus; breadth, one-half circumference of abdomen. After obtaining measurements, fold material once its greatest length; nick slightly at one end the folded border, thus dividing the material in two equal parts. While it is still folded, nick the two folded halves at the same end, so as to divide them in two equal portions,

FIG. 1.



The suspender abdominal bandage applied. Anterior view.

FIG. 2.



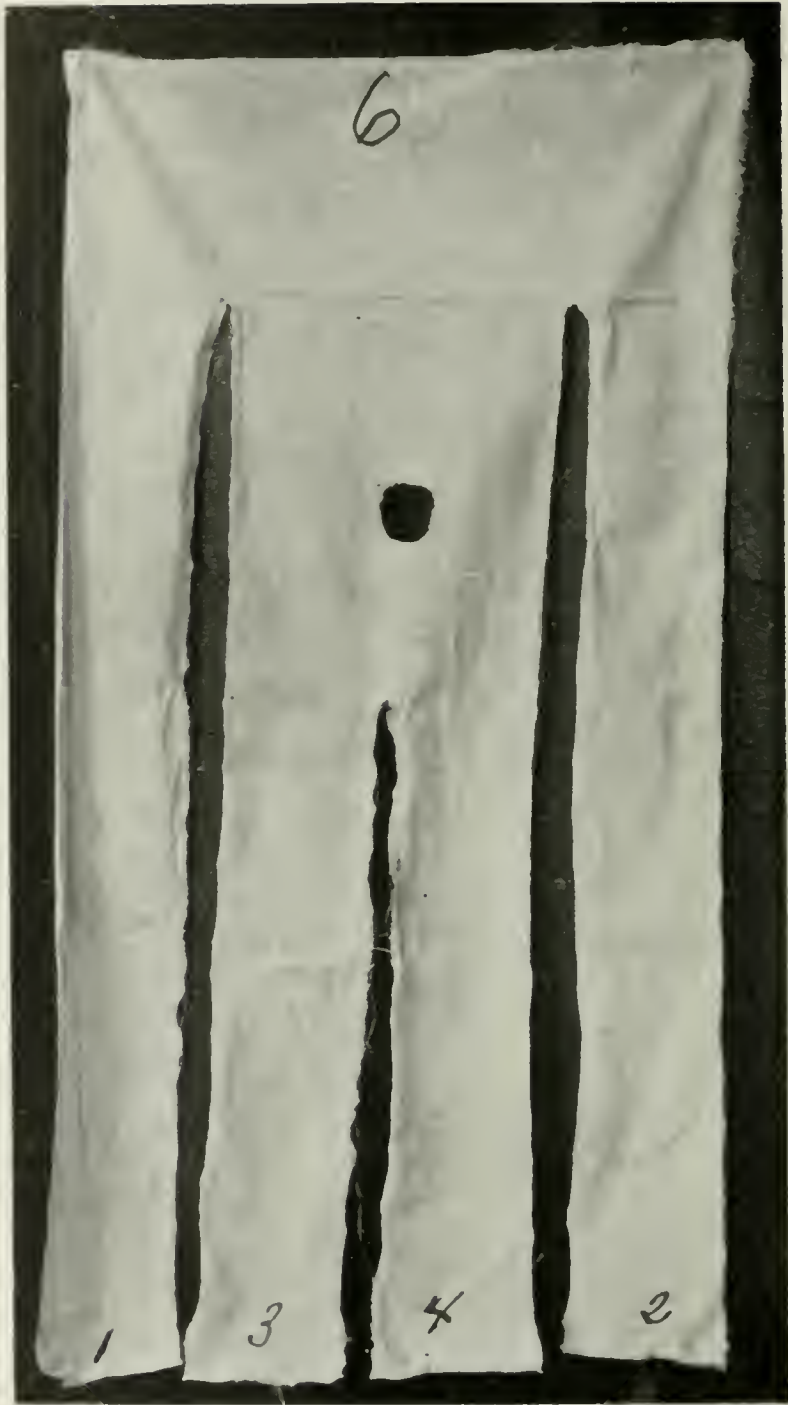
The suspender abdominal bandage applied. Posterior view.

FIG. 3.



The common woven elastic suspender.

FIG. 4.



The 4-tailed genital bandage.

FIG. 5.



The 4-tailed genital bandage applied.

FIG. 6.



The 4-tailed genital bandage applied. Rear view.

making the material when unfolded a four-tailed bandage, whose tails are of equal breadth. Now tear the two outer strips, 1 and 2, as shown in the illustration, to within four inches of the outer end. Wind these about the waist from before backward so that they will cross at the spine; then tie in front (Fig. 5). Slit middle portion after bandage is applied so that the end of the tear will reach just behind the scrotum. While holding the bandage in position, place a fold of cotton back of the scrotum, so bandage will not chafe and will push testes forward. Also apply whatever other dressings may be necessary. Next, draw the two tails, 3 and 4, so as to overlap and form a pocket that will hold the testes snugly and then pass between the legs, over the perineum and tie at back or pin, as shown in Fig. 6, the pin being placed at the small of the back.

SURGICAL PROGRESS.*

GENERAL SURGERY, PATHOLOGY AND THERAPY.

I. Balsam of Peru as a Therapeutic Agent in the Treatment of Wounds.

SUTER, of Innsbruck, said: During the past two years we have introduced, in the surgical clinic at Innsbruck (Prof. Schloffer), the use of Balsam of Peru in the treatment of all recent open accidental wounds, in 562 cases in all. Among these were many injuries of the most severe nature, such as severe complicated fractures with extensive injury to both bones and soft parts. Concerning especially the complicated fractures of the long bones, which will probably be of the most interest, we present over 20 purely conservatively handled cases, omitting traumatic amputations, 1 case of primary amputation, and 2 cases which died shortly after the injury. Of these cases, 14 healed without complications and in only 6 was a secondary operation necessary on account of pus formation, for the most part without temperature elevation. Severe disturbances in the healing of the wounds did not occur in any case, in spite of the fact that there were some very severe compound fractures. In no case was secondary amputation necessary and we could always retain useful extremities.

The same favorable results were obtained in the treatment of extensive contused wounds of the soft parts; in crushed hands and fingers and in all lacerated wounds of the most varied nature. In all of these conditions, healing could be obtained without severe inflammatory processes, even though the wounds were badly lacerated, if the cases only came under our treatment within the first two days. It is important that the Balsam of

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Peru be brought as evenly as possible into all the cavities and spaces of the wound.

Concerning the question as to how the action of the Balsam in accidental wounds is to be explained, I have caused exhaustive experiments to be made, and have come to the conclusion that there are three entirely distinct properties of the drug.

1. The ability of the Balsam to mechanically inclose bacteria, and in this way to eliminate the same as far as the organism is concerned. The defensive agents of the body have, of course, a better chance of acting successfully, the less poisonous material there is present.

2. Furthermore, the bactericidal properties of the Balsam play an important role. Even though they may be slight, such properties are undoubtedly present, as numerous experiments have shown. This slight bactericidal power is of great importance, however, taken in conjunction with the ability of the Balsam to inclose bacteria, as it gives opportunity for a longer continued action upon the same. The exclusion of the bacteria which was at first purely mechanical, becomes absolute after a time, inasmuch as they are killed. It is worthy of note that the Balsam of Peru acts not only as a bactericide, but also gives up into the vicinity, bactericidal substances, which fact I could also prove by experiments. Since the drug in contrast with soluble substances remains for a comparatively long time undissolved in the wound it thus forms, as it were a reservoir of anti-bacterial substances.

3. Finally, Balsam of Peru possesses to the highest degree positive chemotactic powers. In the neighborhood of a drop of the drug, which has been injected into the tissues, is formed a peculiar wall of leucocytes. When one now realizes that not only is the process of phagocytosis caused chiefly by the leucocytes, but that the latter, in all probability, stand in intimate relationship with the formation of those bactericidal substances of the body fluids, *e.g.*, the alexins, it appears justifiable to ascribe a certain favorable action in the process of wound healing to this enormous accumulation of leucocytes, caused by the Balsam.

In addition to these three main properties of the Balsam of Peru, namely—the “inclosing powers”—the bactericidal powers and the chemotaxis, should be noted, also the antagonistic action of the drug in preventing putrefaction in the dead tissues.

This latter power stands, of course, in intimate relationship with the properties described under 1 and 2.

As is well known, many varied reports, concerning the untoward action of the Balsam on the urinary apparatus, have been circulated. These concerned almost without exception cases of scabies treated by inunctions of the drug. We have made exact urinalyses in a great number of cases and have never found albumin present. In no case have we observed any disturbance in the general condition of the patient which could be attributed to renal irritation. Nevertheless special attention must be given to this question.

According to our opinion, the Balsam of Peru treatment, if applied in suitable cases, such as contused and lacerated wounds, gives better results than all other methods.

Through the results of our experimental investigations, the Balsam of Peru method of treatment has been placed to a certain extent, upon a scientific basis, so that its use can no longer be considered quackery. In all of our numerous cases, we have never noted renal irritation due to the Balsam. When such cases are reported it is very possible that the Balsam used was not perfectly pure. There are aromatic bodies, which even in slight traces, can irritate the kidneys. As is well known, the drug is often adulterated and the first requisite is to use only the purest Balsam.

BORCHARD (Posen) remarked that he could, in general, corroborate the favorable results in wound healing, from the use of Balsam of Peru, but that contrary to Suter, he had noted even after the use of relatively small amounts of the drug (3-4 grammes) albumin and casts in the urine, which disappeared after immediate suspension of the Balsam. The preparations used had been obtained from two different drug firms, and varied in their chemical composition only very slightly from the formula of the German Pharmacopœia. Continual careful urinalysis is therefore necessary in the use of the Balsam of Peru.

II. Iodoform-spermaceti Mixture for Filling Bone-cavities.

KOTZENBERG (Hamburg) reports concerning several cases, which have been treated in the First Surgical Division of the Eppendorf Krankenhaus according to the Mosetig-Moorhof method of filling bone cavities.

This method has, up to the present time, not found many adherents, probably due to the fact that the first attempts were attended by numerous failures. These were due mainly to improper technic, both in the use as well as in the preparation of the material used. Concerning the latter point, one must necessarily follow the directions given (*Wiener klinische Wochenschrift*, 1906, No. 44). If one does not have, at his disposal, a chemist well versed in bacteriological technic then one must undertake the preparation himself; for the results depend to a large extent upon the asepsis.

The bone cavities must of course be well cleaned out. K., to obtain this result, uses a set of instruments patterned after the boring instruments of the dentists. This is not absolutely necessary, however, as one can get along well with the ordinary chisels and curettes. The cavity is next disinfected according to the method of Phelps, and the warmed iodoform-spermaceti mass poured in. Here it is necessary to be careful that the mass has a temperature not over 50° C. and not under 40° C. In the former instance the iodine is separated out, whereas, if the mass is too cold it does not penetrate into the finer crevices of the bone.

Eleven cases were treated according to this method. Osteomyelitis gave naturally the poorest results: Of 7 cases, only 2 healed primarily, while 2 others after five weeks still have fistulæ with a cloudy serous exudate. In the 3 remaining cases, the covering over of the iodoform mass with periosteum could not be attained. One case gave up the treatment too soon. In the remaining 2 cases the cavity mass healed well, though erysipelas developed in the one. The other case is worthy of special note, because, though the patient had a marked idiosyncrasy against iodoform, there was absolutely no reaction.

Three cases of bone tuberculosis healed primarily. A bone cyst healed finally, also per primam.

Recurrences can of course occur in the tuberculous cases and fistulæ may remain after extensive osteomyelitis.

It is, however, not a new operation, but only a special method of caring for the wounds, which when compared with our previous experiences, certainly possesses the advantage of materially shortening the course of the disease, though it does not, after all, prevent the scars, which are a necessary consequence of the diseases in question.

HEAD AND NECK.

I. Traumatic Aneurism of the Carotis Interna Cerebralis with Exophthalmus Pulsans.

BECKER (Koblenz) reported an instance of this very rare phenomenon in gunshot wounds of the skull in the case of a soldier. While he was discharging a gun, the barrel burst and some of the pieces of steel penetrated the brain. In the few cases (10), which up to the present time have been recognized, the seat of injury was diagnosed alone by the external symptoms of the pulsating exophthalmus. The diagnosis in our case, however, was made with absolute certainty by means of Röntgen photographs. The case will possibly possess, on this account, a certain interest. The patient was brought, in an unconscious condition, into the hospital, with four large wounds on the right side of the face, one passing through the nose and a second causing complete destruction of the right eye, which had to be enucleated. The left eye, the pupil of which was widely dilated from the beginning, developed at the end of ten days a protrusion and chemosis. The power of sight was so reduced that fingers could be counted only at a distance of 1 m. Marked restlessness with powerful gesticulations alternated with stupor during the first fourteen days after the injury. The protrusion of the left eye increased steadily and the mobility of the same decreased until at the end of three weeks the eye was immobile. The chemosis increased, the pulsation was both palpable and visible, and the veins of the upper lid became dilated and tortuous. Above the eye, over the left parietal region and over the entire head was audible a systolic bruit, which the patient was also conscious of, as a dull humming sound. By means of pressure one could force the eye ball back into the socket, but it would immediately protrude again if the pressure were released. Pressure on the left carotid caused the murmur and the pulsations to cease. Röntgen photographs of the head taken from the side, and also from before backward revealed the presence in the brain of three sharply defined shadows caused by portions of steel. By a combination of both negatives it was shown that one piece of steel about the size of a pea lay in the white matter of the right frontal lobe in the neighborhood

of the falx. A second larger portion, about 3 cm. long and 8 mm. thick, lay on the left side in the basal ganglia, with its long axis passing through the anterior portion of the nucleus caudatus from within and below diagonally upward and outward. The third portion was of the same form as the second, though thinner, resembling the portion of a pen which one inserts into the penholder. This portion lay on the left side of the sella turcica, extending from the anterior to the posterior processus clinoideus, therefore at the point where the art. carotis int. passes through the sinus cavernosus. Here the injury to the artery had taken place and led to the formation of the arteriovenous aneurism with all the consequent phenomena of congestion in the veins of the orbit, dilatation of the valveless vena ophthalmica superior, protrusion of the eyeball, reversal of the blood current in the same and the consequent external pulsation. The treatment, which consisted in cool boric acid compresses with intermittent digital compression of the carotid against the spinal column, could in no way check the constant advance of the condition.

Therefore, in the fifth week after the accident, ligation of the left internal carotid was performed, whereupon the eyeball immediately receded, the pulsation ceased, and the bruit was no longer audible over the head. The patient withstood the ligation well and had no complaints, but during the next fourteen days a peculiar condition of somnolency overpowered him, so that he had to be awakened for his meals. It was not for a couple of weeks that he became completely awake and clear. Then, in spite of rest and the prevention of every form of exertion, there was gradually formed again a pulsating exophthalmus. These symptoms began to make their appearance fifteen days after the ligation. For four weeks the condition varied, improvement alternating with retrogression. Then, however, there was a marked increase in the symptoms and the exophthalmus pulsans recurred as completely as though an improvement had never taken place. Compression of the right carotid now caused the symptoms to disappear while compression on the left side had no effect.

I opposed the ligation of the right carotid in addition to that of the left, firstly, on account of the danger in general after such an intervention, and secondly, I hesitated on account of the untoward after-effects which the first ligation had caused in this man, whose brain was already severely injured. I therefore

sought by means of the following method of compression to cause an improvement in the symptoms.

I made a cylindrical tube of pasteboard about 10 cm. long which fit exactly over the circumference of the orbit. This I fixed exactly over the eye by pouring plaster of Paris about it over the forehead, cheek, and nose. Over the closed eye was placed a small boric acid compress, and into the tube I inserted a "pig's bladder," containing in its lower end 300 g. of mercury. The upper end of this "bladder," which was left untied, was filled with finely cracked ice. In addition to the pressure, the cold was supposed to influence by its constricting action the dilated veins. The patient could endure this pressure from six to eight hours, intermittently, each day, without any effect on his power of vision, which was continually controlled. In addition to this, digital compression of the right carotid was performed three times daily for an hour. By means of this continued treatment, to which was added absolute rest in bed, the prevention of any congestion, etc., the condition improved so much in five weeks that the patient had only a slight exophthalmus, no pulsation, no complaints, only slight ptosis, and could count fingers at 6 m.

The procedures in the treatment were gradually shortened and the patient was allowed to leave his bed. Five months after the recurrence of the condition, the man showed, in spite of the foreign bodies in his brain, the following status: bodily and mental condition normal, slight exophthalmus, ability to open and shut eye well, slight decrease in the mobility of the eye upward and downward, side to side movements normal, very slight ptosis, slight hypermetropia, acuteness of vision 5/20. The veins at the fundus were somewhat dilated and tortuous, but the arteries were normal, and no pulsation was visible in any of the vessels.

By comparing the case with those already in the literature I am induced to give the following resumé concerning the treatment: In young persons with traumatic exophthalmus pulsans, it is to be recommended not to wait long before ligation. Digital compression for fourteen days is advisable as a preliminary mode of treatment. With older individuals, however, the latter procedure should be tried for a longer period of time, and if possible not to resort to ligation. If there occurs, however, a relapse

and the symptoms can be caused to disappear by compression of the opposite carotid, then it might be advisable, in view of the untoward functional disturbances of the brain and sight attending double sided ligature, to recommend the attempt for a longer period of time with the method of combined compression.

II. Concerning Ligature of the Carotis Communis.

(New method for determining the consequences of the occlusion).

JORDAN (Heidelberg) said: Ligature of the common carotid still remains a dangerous operation since in 25 per cent. of the cases brain disturbances occur and in 10 per cent. fatal softening of the brain. The prognosis is, on that account, always doubtful and in the individual cases it is often left to chance whether the patient awakens at all after the narcosis, whether he develops a hemiplegia or perhaps dies of a progressive softening of the brain.

In order to prevent such undesirable surprises, the author recommends a new procedure, which proved itself of value in animal experiments as well as in an operation for carcinoma of the neck; namely, previous loose constriction of the carotid for forty-eight hours. By carefully constricting the artery by means of a small tape or catgut just until the peripheral pulse ceases, there is no injury to the intima and no clot formation. If one removes the ligature after two days, the peripheral pulse reappears and soon attains the normal strength.

This preliminary ligation must be performed under local anæsthesia since the cerebral symptoms may occur immediately after the narcosis and the determination of the onset be interfered with. If disturbances occur after the constriction one can immediately remove the ligature from the wound, which has been left open and the circulation restored to normal. By gradually increasing the constriction of the ligature one can, under certain circumstances, cause the development of a collateral circulation which may at first have been insufficient.

Finally the method may be used as an extra security in the suture of wounds of the larger arteries.

CASE.—Fifty-nine-year old man, with recurrent carcinoma of the right side of the neck.

Preliminary Operation.—Exposure under local anæsthesia of the carotis communis below the tumor, insertion under the artery of a gauze strip and the loose constriction of the vessel by means of double catgut.

No consequent symptoms, removal of ligature after forty-eight hours with immediate reappearance of the peripheral pulse. Four days after the preliminary operation, extirpation of the tumor with resection of the entire carotis communis external et internal, the N. nervus vagus, sympathicus. the anterior cervical muscles and the overlying skin. No subsequent symptoms with the exception of contracted pupils and hoarseness. Normal course of wound healing. Exitus at end of three months from recurrence.

III. Supra Hyoid Pharyngotomy Preliminary to the Removal of Tumors of the Nose-Pharynx.

M. HOFFMAN, of Gratz. The difficulties in the removal of naso-pharyngeal tumors consist for the main part in the inaccessibility of the field of operation and in the profuse hemorrhage. There is a method, however, which allows the same general view, as the formerly used buccal and facial methods of exposure and lends itself better to hæmostasis. This consists in a transverse incision above the hyoid bone. Following the recommendation of Jeremitsch, this operation has been performed for various conditions. Von Hacker removed, according to this method a sarcoma of the base of the tongue. The view thus gained of the meso-pharynx, induced me to attempt, first on the cadaver, the removal also of tumors from the epipharynx. The important point in the use of this incision is to preserve the muscles attached to the lateral portions of the hyoid bone, in order to preserve the function of swallowing. By separating widely the walls of the opened and extremely elastic pharyngeal tube and pushing the soft palate forward, one may attain a good view of the base of the skull. This field may be materially enlarged by splitting the soft palate and the muco-periosteal covering of the hard palate in the median line, and after retracting these parts to either side removing the posterior portion of the hard palate, according to the method of Gussenbauer.

The removal, in a 27 year old woman of a sarcoma of the base of the skull by means of such a *pharyngotomia supra hyoidea transversa*, demonstrated plainly that the operation could be performed completely under control of the eye and with only slight hemorrhage. If one first controls the slight bleeding before incising the pharyngeal mucous membrane, no blood enters the pharynx as a result of the preliminary procedure. The tumor itself cannot be injured during this preliminary operation. If

the tumor bleeds more profusely during its removal, then the blood collects for the main part in the epipharynx and cannot possibly be aspirated, especially if a soft rubber tube has been previously introduced into the larynx for the anæsthesia. The bleeding points can now be tamponed under control of the eye, and in case of more profuse hemorrhage the ext. caxatia may be ligated by slight lateral prolongation of the incision. The cosmetic results of the operation, which may also be performed under local anæsthesia, are good since the scar lies in the most hidden part of the neck. The aspiration of blood during the operation can with certainty be prevented, so that a tracheotomy is unnecessary. The danger of an aspiration-pneumonia is certainly very slight, while the mechanism of closure of the larynx as well as its reflex excitability remains unimpaired. Since the hyoid bone is left in its natural position through the preservation of its laterally attached muscles, the mechanism of swallowing remains unimpaired. The normal anatomical relations are competely preserved. The patient operated upon by us could swallow well on the third day after the operation. This one favorable result does not suffice of course, for an absolute judgment concerning the usefulness of the method. One has to consider the size, site, and origin of the tumor in order to determine in each individual case the best mode of procedure. Still the assumption seems justifiable that the pharyngotomia supra hyoidea transversa makes possible the removal of naso-pharyngeal tumors under complete control of the sight and without the danger of profuse hemorrhage. By means of this operation the point of origin of the naso-pharyngeal fibromata, *e.g.*, base of the skull, is well exposed. In the case of malignant tumors, the operator has also the advantage that by means of slight lateral prolongation of the wound, he can convince himself concerning the presence of metastasis in the upper jugular glands.

SCHLOFFER (Innsbruck) had extirpated an adenoma of the hypophysis cerebri by means of the nasal method. The diagnosis was made by the Bitemporal Hemianopsia and a Röntgen photograph. The indication for the operation was continued headache, with very marked exacerbations. Although the patient had given his consent to the enucleation of an eye, if this should prove necessary, the removal of the orbital contents, which S. had at first thought advisable, proved unnecessary. The expo-

sure of the hypoph. cerebri through the sphenoidal veins was accomplished surprisingly easily after the entire nose had been drawn aside and the inner wall of one orbit and the antrum of Highmore removed. Between one quarter and one fifth of the enlarged cerebral appendage was left behind and the wound tamponed with Balsam gauze. There was a flow of liquor cerebro-spinalis for 14 days. No signs of meningitis three weeks after the operation. It is proven by this case that the extirpation of tumors of the hypophysis cerebri are much more easily performed through the sphenoidal sinews than one might expect, and that the much feared post-operative meningitis is not a necessary sequel.

THORAX.

I. Surgery of the Heart and Pericardium.

L REHN, of Frankfurt. A. M. 1. The presence of a cardiac injury is generally indicated by the site of the external wound, the course of the bullet or dagger and the nature of the hemorrhage. If an injury to the heart is suspected it is very important to note whether there are present symptoms of the so-called "heart tamponade" or "pressure on the heart," the latter being a term which analogous to "pressure on the brain," the author recommends to apply to that complex of symptoms due to an accumulation of blood in the pericardium. If the hemorrhage into the pericardium takes place rapidly, the pressure on the heart can lead quickly to death; whereas if it is more gradual, the the pericardium can expand, accommodating itself to the increased tension. The reserve spaces of the same become filled and there are formed the so-called Recessus pericardii, by means of stretching and greater prominence of the pericardial reduplications at the points of origin and exit of the blood vessels. Below and to the left there is formed a large recess, to the right side a smaller one and above the so-called "space of the dome." These recesses and their ability to dilate were demonstrated on an instruction anatomical preparation. The heart becomes gradually "strangled" through compression of the auricles and the venæ cavæ and it becomes exhausted under the increasing pressure. This exhaustion is due to a large extent to an improvement of the nutrition of the heart on account of the insufficient filling of the arteriæ coronariæ, and also an obstruction of the

exit of blood through the vena magna cordis. If no incision is made the heart eventually ceases to beat. "Pressure on the heart" causes characteristic subjective symptoms. It is important to note carefully any increase in the area of cardiac dulness. In an early stage, the Röntgen apparatus often shows an enlargement, which cannot yet be made out by percussion. The presence of cardiac murmurs, which may be varied in nature, is important in the diagnosis of cardiac wounds.

2. Concerning the question of operation interference in cases of cardiac wounds, spontaneous recovery does occur in a certain percentage of cases. However, a person with a sutured heart is undoubtedly in a better condition than one in which spontaneous healing has taken place. It is of course clear that immediate operation is indicated where there are threatening symptoms of cardiac pressure, or severe internal hemorrhage. Foreign bodies such as daggers, etc., which remain sticking in the heart, are to be removed only when the heart has been sufficiently exposed.

3. Exposure of the heart. The numerous methods by means of bone-flaps are too heroic and accompanied by danger of infection. A conservative mode of procedure is to be recommended first making an intercostal incision externally from the border of the sternum and corresponding to the external wound. If necessary, one or more ribs must be resected. If the heart is not yet sufficiently accessible, a second incision perpendicular to the first must be made along the border of the sternum. After cutting through the costal cartilages, the "osteo-cutaneous" flaps above and below are to be forcibly retracted and it may be necessary also to chip away a portion of the sternum. The survey thus gained, is very good. One shall attempt if possible to avoid the pleura or at least to prevent any gross injury to the same. A preservation of the pleura is generally impossible since the latter is generally opened by the initial injury. If possible the operation is to be performed with the Brauer apparatus or in the Sauerbruch chamber. An exploratory pericardiotomy is, under certain circumstances, indicated where the diagnosis is not certain. In this instance, the author recommends a particular method: an incision along the lower border of the seventh rib on the left side, toward the base of the ensiform, cutting through the seventh costal cartilage, gradual advance upward under the sternum to that portion of the pericardium, which is uncovered by pleura.

The sac is now easily opened and if necessary drained since tubes may be easily introduced into the same from either side. Starting with this wound, the necessary incisions for exposure of the heart may be immediately made.

4. Various methods have been used to control the often profuse hemorrhage during the suture of the heart such as tamponing the wound with the finger, compression of the entire organ, drawing on the heart toward the external wound, bending the heart over the border of the sternum. The author recommends compression between the fingers of the venæ cavæ at their point of discharge into the right auricle, in order to thus operate with a minimum loss of blood. He had convinced himself by means of experiments on dogs that this method was practicable and could be borne for a short time without injury to the heart. The suture of the heart is best performed with interrupted silk sutures.

5. The extensive statistics include 124 cases of suture of the heart with 40 per cent. recoveries. The points noted are the nature of the injury, the site of same on the heart, the cases operated upon "extra-pleurally," form of drainage with results, the complications in the successful cases, causes of death in the fatal cases (44 per cent. hemorrhage, collapse, 40 per cent. infection).

Concerning the question of drainage, the author recommends primary closure of the pleura, but drainage of the pericardium with rubber tubes. In addition to this, the author had collected from the various operators and reported statistics concerning the ultimate results on the operated cases.

Extract from the clinical history of a second case of cardiac suture, which the author performed in November, 1906. It was a case of very extensive stab-wound of the right ventricle Exitus 1½ days after operation.

ABDOMEN.

I. New Contributions Concerning Resection of the Liver.

DR. AUSCHÜTZ (Breslau). The material observed (20 cases from the clinics at Rostock, Königsberg and Breslau) showed that one could, in a very simple manner, attain good results in

the resection of even large portions of liver tissue. It is decried that complicated methods or unusual appliances are necessary in resection of the liver. (In all cases, single intraperitoneal operation, no foreign bodies left in the abdominal cavity). Only one case died as a result of the operation and that was due to either iodoform or chloroform poisoning. In the resection of liver tissue, the important question is the ligation of the branches of the portal vein and of the artery. That this is possible is proven by the experiments of Kusnetzoff and Penski.

In resections one can simplify the ligation of these vessels in two ways. 1. By making a clean, smooth incision through the liver tissue. The bleeding vessels on this smooth surface can be grasped with clamps and ligated. If one separates the liver tissue bluntly then the vessels, after the extreme stretching, tear and retract; they can then be grasped only with difficulty and uncertainty. In case of the smooth incision, however, they can be easily found. The liver wound should, if possible, be made in the form of a wedge and closed by means of sutures.

2. The second method of procedure consists in the application of ligatures en masse as suggested by Kasnetzoff and Penski. One does not need however a particular guiding suture or special instruments but can get along just as well with the Deshamps needle. The ligatures should be slowly but firmly tied.

In suitable cases one can make use temporarily of an elastic ligature. In the great majority of cases one can close the peritoneal cavity without any tamponade. Liver resection is often facilitated by cutting through the ligaments of that organ. In all cases where portions of the dome of the liver, which are accessible only with difficulty, are to be operated upon, it is recommended not to hesitate to resect the border of the ribs on the right side and the ligamentum suspensorium.

The transpleural method should be abandoned in all intraperitoneal affections. In cases of liver injuries, subphrenic abscess, etc., the resection of the free border of the ribs should be substituted in its place.

WULLSTEIN (Halle A. S.) had also during the past year made a long series of experiments on the cadaver, with the intention, by means of temporary resection of the free border of the ribs on one or both sides, to expose the surface of the liver and the stomach as well as those lymph glands lying in the region between

the stomach and diaphragm, in front of and to either side of the spinal column. W. can also substantiate the assertion of Auschütz, that the danger of opening the pleural sac from the anterior wall of the thorax is not to be feared as long as one remains in the buvean, that is below the seventh intercostal space. Nevertheless it is well to dissect away the resected ribs posteriorly from the insertion of the diaphragm close to the perichoridral tissue.

RIEDEL (Jena) had sad experiences with infection of the border of the ribs. After infection of the wound surface there occurs a progressive inflammation of the border of the ribs, whereby the cartilage becomes bathed in pus. In this respect there is a great difference between the costal cartilage and the ribs. The sub-serous excision of the gallbladder is only feasible in the uninfected cases. It is important to ligate separately and surely the art. vesicæ fellii. Not until then does the cysticus become free and can be ligated.

MALE GENITO-URINARY ORGANS.

I. Extirpation of the Prostate.

H. KUMMEL (Hamburg) emphasizes the fact that good functional results may be obtained by means of the Bottini operation, also by castration concerning which K. himself had collected numerous statistics, furthermore by means of ligation of the art. iliaca interna and resection of the vasa deferentia. Nevertheless, the results are for the most part not to be considered as permanent; and since the author considers that hypertrophy of the prostate should be recognized as an independent local condition in itself, as a tumor, which, like all tumors, must be removed, he therefore considers the intra-capsular prostatectomy as the best therapeutic procedure in these cases; the one which, even though it is the most heroic, guarantees the best results. He, of course, recommends even more emphatically the complete removal of the prostate in carcinoma of that organ. For the diagnosis, he recommends, in all cases, in addition to the usual methods of examination, the use of the cystoscope, which gives an exact insight into the gross anatomical picture.

As contraindications to the operation should be mentioned: marked disturbance in the general condition of the patient, marked

arterio-sclerosis, chronic use of the catheter, diffuse bronchitis, complete loss of vesical contractility, and a renal insufficiency which does not respond to treatment. With regard to the latter, he recommends under all conditions cryoscopy of the blood, a method which had never failed him when properly carried out.

Concerning the two usual methods of operation, the perineal and the suprapubic, both of which show the same rate of mortality, K. prefers the latter method, since it guarantees a better view of the operative field, an easier removal of any complications which may develop and the easier prevention of any fistula formation. Technically also, it presents fewer difficulties. K. sees, in the supra-pubic operation, an important disadvantage in the fact that the patient cannot be allowed to get out of bed so early. Nevertheless, he recommends the perineal route in all cases where the enlargement of the organ is for the main part toward the rectum and where an operation is necessary in very stout individuals.

Among 41 prostatectomies which he had performed, the diagnosis of carcinoma was made in 9 cases. Of these 3 died shortly after the operation, (apoplexy, cardiac weakness, carcinoma of the intestine with metastasis) 2 after three and four months respectively. The remaining patients were living at the end of a year and could urinate spontaneously without any complaints. In the 32 cases of hypertrophy of the prostate, the perineal route was chosen in 11 and the supra-pubic in the remaining cases. Eight of these patients, whose ages ranged from 63 to 90 years died soon after the operation and three later from intercurrent diseases. A rectal fistula developed in one case as a result of the operation. This patient died of bronchitis and cardiac weakness some time after a secondary operation for closure of the fistula. A second patient complained of disturbance in the sexual functions, a third, of painful priapism. In all of the remaining cases the results of the operation were most satisfactory, the bladder functions were entirely normal and the urine could be passed in a stream. The capacity of the bladder was such, that the patients had to urinate only every 3 to 6 hours in the daytime and at night only once or perhaps not at all. Three patients complained that they could not urinate as well as shortly after the operation. It developed in these cases that strictures were present in the pars membranacea after the removal

of which the symptoms disappeared. K. considers it, therefore, most important to pass sounds after some time (after about one half year) on all operated cases, in order to prevent stricture formation.

He had, for some time, performed the operation under spinal anæsthesia using tropo-kokain and adrenalin. He had formerly used the scopotamine—morphine—æther narcosis. In the use of the lumbar anæsthesia K. sees a distinct advance in the performance of prostatectomy, which is not to be underestimated, especially since general anæsthesia has to be dispensed with in many elderly patients, on account of the heart and lungs. K. makes the following resumé of his views concerning extirpation of the prostate.

1. In the cases of chronic, complete, and incomplete retention of urine, the permanent catheter is first to be tried, if there are no complications and catheterization can be easily performed. If this treatment is not successful and the patient is still compelled to empty the bladder by means of the catheter, then the operation is to be recommended.

2. The extirpation of the prostate is the most heroic method of operation and accompanied with the most dangers. Still with a favorable course, it promises a sure and permanent result.

3. In the choice of the mode of operation, perineal or supra-pubic, one must be guided by the individual case. Where the hypertrophied organ projects deeply toward the rectum and but slightly toward the bladder, as well as in patients where the abdominal walls are well developed and fat, one should choose the perineal route. If the prostate projects more toward the bladder, than the trans-vesical method in general, one should give the preference to the supra-pubic method since the technic is easier, the length of time of healing shorter, the after-treatment simpler, and the danger of incontinence and fistula-formation is less.

4. The actual danger of the operation appears to be about the same in either method.

5. The contraindications to prostatectomy are: marked disturbance in the general condition of the patient, extensive arteriosclerosis and diffuse bronchitis, renal insufficiency, which does not respond to treatment, and complete loss of vesical contractility.

6. Radical operation is always indicated if carcinoma is suspected.

SCHLESINGER (Berlin) reported the results at the Jewish Krankenhaws (Prof. Israel), nineteen prostatectomies—operative mortality=3 (one case from pulmonary embolism a second from coma diabeticum, the third from a post-operative anuria, cause not determined). One death five months after operation from pyelitis. Subsequent course not followed in two cases. One incomplete result in a case of partial prostatectomy. Perfect result in 12 cases. Author recommends caution in the indication for operation on account of the relatively high mortality, though cause of death cannot be ascribed to imperfection in technic.

Almost all operations under lumbar anæsthesia.

Supra-pubic method preferred:

1. Because it is more easily and quickly performed.
2. Because the median lobe can often only with difficulty be removed by the perineal route.
3. Calculi may be easily overlooked in the perineal operation.

Care of the wound:

1. Bladder completely sutured (danger of post-operation hemorrhage almost nil).
2. Tamponade of cavity left by removal of gland. Catheter in urethra (usual method).
3. Drainage from above and counter opening (only in cases of severe infection).

Fact that incontinence does not result post-operationem is ascribed, by Schlesinger, to the vicarious assumption of this function by the sphincter externus.

VOELCKER (Heidelberg). The experiences at the surgical clinic at Heidelberg comprise 32 cases of perineal prostatectomy during the past six years. The results are as follows: three patients died directly after the operation: one of collapse after chloroform narcosis; the now generally accepted lumbar anæsthesia appears to be less dangerous. A second patient died as the result of an injury to the rectum, with ascending infection of the urinary apparatus. Injury to the rectum occurs generally at the point where the pars. membranacea urethræ is bound by muscular bundles to the rectum, and where sharp dissection with the knife is necessary to separate these structures. At this point

it is necessary to use great caution and to control the procedure by means of a finger in the rectum. A third patient died of a diffuse purulent peritonitis. Although at the autopsy one could not make out any injury to the peritoneum, it was probable that the peritoneal prolongations over the seminal vesicles had been opened, an accident which can probably be prevented by a more exact attention to the anatomical details.

Two of the patients died after their discharge from the hospital; one from infection of the urinary apparatus; he had a cloaca as a result of injury to the rectum; a second committed suicide at home, 31 days after the operation. This act was probably induced as the result of a confused mental condition of the patient due to uræmia, or was due perhaps to doubt on his part, on account of an incomplete recovery from his painful disease.

With regard to the danger of the operation, may be mentioned the fact that these patients are often very critically ill for the first few days after the operation. Three patients especially were very critically ill, but eventually recovered. The careful supervision of an efficient perineal drainage of the bladder is very important in the prevention of urinary retention and septic infection.

In one case we attained a permanent poor result. The patient operated upon six years before, had suffered continuously from a chronic purulent cystitis, recurring attacks of epididymitis, and from para-vesical and peri-ureteral abscesses. In this case the prostate was removed as a whole with its capsule by the perineal method, and during the course of healing there was formed only an irregular urethra in the scar tissue. It was impossible, in this case, to perform the intracapsular enucleation of the gland.

In 5 cases the patients were left with moderate complaints, two suffered from perineal fistulæ. Concerning the technic of the operation may be mentioned the fact that the smaller the incision in the pars memb-urethræ, the less is the liability to fistula formation. It is better if one opens the urethra only in the pars prostatica. Two patients were left with a permanent weakness of the sphincter, although this condition was present, to be sure, before the operation; one patient suffered from chronic cystitis.

On the other hand, we have attained satisfactory permanent results in 21 (65 per cent.) perineal prostatectomies.

Our experiences concerning the supra-pubic prostatectomy are fewer, since we have used this method in only 7 cases. The operation from above is undoubtedly more quickly performed, completed in many cases, in fact, with remarkable rapidity. Good drainage through the bladder wound above as well as through the urethra is important during the after-treatment. The danger of pneumonia seems to be greater after the supra-pubic operation. The perineal operation, though technically more difficult, is anatomically more correct, and, all things being equal, seems to be less dangerous if performed well.

GÖBELL (Kiel) reports the results which have been obtained with prostatectomy at the surgical clinic of Prof. Helferich. The hypertrophied gland was removed six times by the perineal and fourteen times by the supra-pubic method. Only one patient died immediately after the operation, a case operated supra-pubically. The supra-pubic prostatectomy according to the method of McGill-Freyer is preferred, as being a procedure which the patients bear, for the most part, well, if used in combination with the Bier method of spinal anæsthesia. Fistulæ resulting from the perineal method remained open much longer than after the supra-pubic operation. In two instances it was necessary to close perineal fistulæ by means of plastic operation. Subsequent treatment after the supra-pubic operation must be very careful. Frequent bladder irrigations through the catheter and two drains introduced through the wound in the bladder. It is to be recommended during these bladder irrigations, to massage, every now and then, from the rectum, the space left by the removal of the prostate gland. Also for the patients to sit up early and take deep breathing exercises.

Prostatectomy was performed three times on account of malignant tumors. Exitus in all cases from pyelonephritis.

REERINK (Freiburg). In many cases it is sufficient to open the urethra and remove only smaller portions of the prostate. The urethra does not only have to be opened but must be separated as much as possible in the membranous portion. The patients can get up soon after these procedures.

P. ROSENSTEIN (Berlin) reports a perineal prostatectomy with favorable result in a 76 year old apoplectic (operation under

lumbar anæsthesia 0.075 Tropakokain) a case which seemed to him worthy of note on account of a complication with calculi. A retention of urine developed three weeks after the operation, caused by the formation throughout the entire extent of the urethra of a column of calculous material (descended from the kidneys), which had to be removed with the forceps. The perineal scar withstood well the enormous distension of the bladder due to this urinary retention. Subsequent course normal.

RYDYGIER (Lemberg) recommends early operation before catheterization fails. Supra-pubic operation preferred in enlargement of the median lobe, otherwise perineal method. R. performs the intracapsular prostatectomy leaving attached to the urethra two strips of the gland about 1 cm. thick. The urethra itself is not opened and all the rest of the prostate is removed. The technic is to be sure, more difficult, but, if the operation succeeds it is much less dangerous. R. demonstrated his method by means of photographs. Perineal incision in the median line (only exceptionally according to the method of Zuckerhandel). One then bores in with the finger in an anterior direction alongside of the M. levator ani, isolates the M. recto-urethralis and divides the same. The posterior surface of the prostate is thus exposed. The capsule is now incised on one side, the prostate separated by means of the finger and rotated until one can reach the portions of the gland lying in front of the urethra. The prostate is finally excised smoothly along the urethra and it is possible in many cases to operate without injury to the same. Incontinence of urine and fistulæ cannot develop under these conditions. Hemorrhage is less in the perineal method.

DE QUERVAIN (Chaux-de-fonds) considers the supra-pubic prostatectomy as the less dangerous, based upon the results of 12 cases. The hemorrhage is generally slight. Only two fatal cases in the 12. It is important to irrigate the permanent catheter after a few hours with sterile saline solution. All healed cases can urinate spontaneously and also retain the urine.

RUMPEL (Berlin) reports the results at Von Bergmann's clinic. Preliminary cystoscopy is important to determine the mode of operation. Many prostates which surround the urethra in the form of a solid wall, cannot possibly be operated upon according to the supra-pubic method. Author warns against filling the bladder with air on account of the danger of embolism.

In the after treatment he uses the double drainage. Bladder irrigations to be given at least 5-6 times daily. The fistulæ close quickly. Psychological disturbances after prostatectomy are not rare, severe melancholia developing in numerous cases. Author had two cases of suicide.

FREUDENBERG (Berlin) presents two preparations from cases of supra-pubic prostatectomy. In both cases he had performed complete enucleation of the gland, urethra generally included. In one of these cases it seemed by rectal examination as though gland tissue had developed again, and there had taken place a prostate regeneration. This regeneration generally proceeds from the capsule. These patients retained their potency, although a preliminary vasectomy had been performed. F. had one death in seven prostatectomies. As a general rule the urethra may be disregarded, which simplifies the wound conditions and makes the performance of the operation easier and quicker. Author does not recommend elevated-trunk position.

PREINDEL (Troppan) reported two cases, in one of which there was present a balm-like occlusion of the urethra due to one of the lateral lobes. In both of these cases the *potentia coeundi* was retained. P. lost one man from a urinary retention at the end of a year after a successful Bottini operation.

ISRAEL (Berlin) thinks the indications for prostatectomy should be as narrow as possible. In a large material he had performed the operation only 19 times. The fact that a patient is compelled to use the catheter, is not considered an indication. On the other hand he does not consider a flabby inactive bladder as a contraindication. He had only unfavorable results after castration. The *sectio supra-pubica* is to be recommended on account of the ease of performance and the impossibility of injury to the neighboring organs. These injuries after the perineal operation are sometimes very great, and author considers that every prostate can be removed through the supra-pubic route. One can generally operate through a small incision and must depend rather upon the sense of feeling than upon the sight. One need enlarge the incision only if there is danger of tearing the bladder, as when large prostatic tumors are to be removed. The presence of much adipose tissue does not contraindicate the *sectio-alta*, rather the contrary. There is nothing to prevent the addition of a transverse incision to the original one if necessary. The

prostatic cavity should always be kept tamponed to prevent the possibility of late secondary hemorrhage, which can never be predicted.

PAYR (Graz) had operated in two cases under local anæsthesia. Fifteen minutes before the operation, he injected 50 c.c. of a 1 per cent. eucaine solution into the bladder and then operated under Schleich anæsthesia. The enucleation is made easier by infiltrating the deeper tissues with the Schleich solution. He had never seen any bad results from filling the bladder with air.

SCHATHEIS (Wildungen) had performed *sectio-alta* in 9 cases. Among these were two deaths on the seventh day post-operationem. There was present here a *prostata circumvallata* about the urethra. Another case died on the twenty-first day. In two cases, the result was nil, while in another there was left behind an abdominal fistula. S. does not hesitate to enucleate the gland in toto. The apparently flabby bladder is no contra-indication to the operation. One should not forget the possible occurrence of impotency. Referring to a case in which the ureters united in the hypertrophied prostate S. lays weight upon the importance of making visible the ureters before the enucleation and to this end recommends the previous subcutaneous injection of either methylene blue or indigo-carmin.

HELPERICH (Kiel) is an advocate of the supra-pubic operation. The difficult cases are those where hard tumors are present. He recommends that the operator pass his own finger into the rectum in order to press the gland forward, rather than leave this to an assistant. He had operated in a similar method as Wallstein with partial resection of the symphysis.

TH. ROVSING (Kopenhagen). My views concerning prostatectomy for hypertrophia *prostatæ* are entirely different from those surgeons who treat all cases of prostate hypertrophy, or at least those complicated with chronic urinary retention (Kummel), by means of the *prostatectomia totalis*. I prefer to treat these elderly patients in a much more conservative manner, and it is only when I am absolutely compelled to, that I suggest to these generally very weakened old men such a dangerous operation as a prostatectomy.

Among my 150 operations for prostatic hypertrophy, are about 90 vasectomies without a death, and with 60 per cent. cures.

I agree with Helferich, that the vasectomy is a most excellent operation if it is performed early and in suitable cases; (that is to say, cases of diffuse soft hypertrophy). There was also not a death among 50 supra-pubic cystotomies. In only 10 cases have I undertaken a partial and in 6 cases a complete prostatectomy, being compelled to on account of suspected malignancy, threatening hemorrhages, or a form and size of the intravesical prostatic tumor which made the application of a Pezzer catheter impossible.

Prostate hypertrophy is in itself a perfectly benign disease, and as a matter of fact in only 16 per cent. of the cases, where a urinary retention is the result, can it be considered a disease, demanding operative interference, and the treatment should have as its object the removal of the urinary retention and its consequent dangers. If this end may be attained in the great majority of cases by such relatively harmless methods as vasectomy or cystotomy, then I consider the dangerous and indeed often unsuccessful prostatectomy as the chosen mode of procedure, to be both illogical and unjustifiable, and I should like also to ask why we should remove such an important organ as though it were a malignant tumor, when the real indication is only to provide exit for the urine.

The results of prostatectomy which have to-day been brought out, have confirmed me more than ever in the opinion that my standpoint is correct. For, firstly, it has been shown that the operation is very dangerous to life, all of the statistics showing an immediate post-operation mortality of over 10 per cent.—some over 20 per cent. and even up to 30 per cent. We could perhaps content ourselves with this result if it were true, as many of the adherents of the operation claim, that the surviving patients declare themselves entirely contented with the result of the operation. Still I should like to call your attention to the enormous number of patients who are compelled to suffer from a vesico-rectal fistula as a lasting remembrance of their operation, to the many cases of incontinentia urinæ, of perineal fistulæ, further to those cases where the urinary retention continued, entirely uninfluenced by the operation, all of which are cases which prove that the results of prostatectomy are always very uncertain. Finally among the so-called "successful prostatectomies" we find a large number of suicides, a fact which should also give us material for earnest consideration. Rumpel asks if anyone might think of the

possible connection between prostatectomy and suicide. In this connection I should like to call attention to the fact, that for many years I have warned concerning this danger of post-tectomy, demonstrating the often incurable psychic depression, which may be caused by inflammatory destruction of the prostate due to prostatitis gonorrhoeica, tuberculosa et phlegmonosa. I am firmly convinced that there is a very intimate relation here between these cases of suicide and the prostatectomy.

If I am compelled to undertake the operation I prefer the Freyer supra-pubic method. Technically this operation is so wonderfully easy and rapid of performance that I readily understand and in this respect share the enthusiasm of the gentlemen, who have resorted to it, but the operation is just as dangerous as it is beautiful and seductive. Of four cases of prostatectomy operated according to the Freyer method, one died on the second day of cardiac asthenia, a second developed on the fourteenth day post-operationem, after the external wound was practically healed, a profuse hemorrhage from the prostatectomy wound, and death was only averted through a firm tamponade after the method of Miculicz. In two cases there developed narrow strictures which demanded the constant use of bougies, and in one case the urinary retention was in no way influenced. Of two cases of perineal prostatectomy one died on the third day and the other developed a calculous deposition in the prostatic cavity with urethral strictures.

I should like to win, if possible, all surgeons to the following compromise: in complete urinary retention to limit one's self in all cases to the cystotomia supra-pubica, with no anæsthetic; this operation is entirely without danger and relieves for the time being the urinary retention and all its consequent dangers.

Following my method of suturing immediately, the wound in the bladder firmly and closely about a Pezzer catheter, any escape of urine after the operation is absolutely impossible and the uneventful healing of the wound is thereby insured. A cystitis can be cured quickly by means of nitrate of silver treatment and the renal functions, which are always impaired and insufficient in these advanced cases, can be quickly improved, thereby also the patient's general condition. When now the patient has again regained his strength, it is time enough to discuss with him, whether he is so inconvenienced by his fistula that he would care

to undergo a prostatectomy with all its dangers and uncertain results. As a rule, the patients would declare themselves perfectly satisfied and wish to retain their prostate glands. In those individual cases, however, where the prostate has developed so far forward into the bladder, that there remains no place for a catheter, and where hemorrhages and tenesmus make life unbearable, then the Freyer prostatectomy can be performed through the bluntly dilated supra-pubic fistula under much better conditions, and as a rule without anæsthesia.

II. Modifications of the Sectio Alta.

DR. WULLSTEIN (Halle A. S.). Sectio Alta is indicated especially in diseases of the prostate, in vesico-vaginal, or recto-vesical fistula, and in tumors of the bladder which are situated either in the fundus or in the neighborhood of the ureters.

In this temporary total resection of the symphysis, W. makes a skin incision from a point one finger's breadth above the centre of Poupart's lig. on the right side, in a curved direction, convex downward, close to the root of the penis, which is drawn strongly downward, to a corresponding point on the opposite side. Thereupon the ligamentum suspensorium is incised close to the root of the penis, the inguinal canals opened by incisions in the aponeurosis of the *M. obliquus externus* in both sides, the vasa deferentia displaced laterally. Openings are now made in the fascia transversa just above the tubercula pubica near the outer border of the recti muscles and the anterior wall of the bladder pushed back from the symphysis by means of a finger introduced through the above openings. A gigli saw is then introduced through one of the above openings, passed posteriorly closely about the symphysis, and the latter sawed through in a line beginning below at a point in the arcus pubis just lateral to the root of the penis, and passing above through the spine of the os pubis. The same is done on the opposite side and a "double pubotomy" thus performed. By means of a chisel blow the arcus pubis is now separated transversely from the remaining portion of the symphysis, and left intact below as a narrow "bracelet of bone" with the attached ligamentum arcuatum inferius and the root of the penis. The symphysis is thus totally resected and retracted upward.

This method of resection of the symphysis, fulfills all the requirements for the subsequent operation on the bladder, and takes into consideration also all the anatomical conditions present, which might possibly suffer as a result of another mode of procedure. Since the horizontal rami remain completely intact, any lesion of the vasa cruralia and obturatoria and of the nervus obturatorius, is out of the question. Furthermore, since the median portion of the obturator foramen remains surrounded by a bridge of bone, the tension of the memb. obturatoria does not suffer injury and any predisposition to hernia-formation is prevented. And, thirdly, in spite of the fact, that the arcus pubis is separated laterally in its continuity from the rest of the pelvis, it still remains as a rim of bone, in intimate contact with the root of the penis and lig. arcuatum and the vessels and nerve to the dorsum of the penis, and the plexus of santorini are thus most carefully preserved. The erectile mechanism of this organ is thus in no way impaired.

When the operation has advanced to this point the bladder, completely emptied of urine to prevent infection, is filled very slowly and carefully with air, by means of a Nelaton catheter and a syringe. In order to prevent with certainty the occurrence of air embolism, the capacity of the bladder is accurately determined the day before by filling it with boric acid solution. Since the entire anterior wall of the bladder is exposed, the latter does not need to be filled, to the extreme, with air.

In making the incision into the bladder it is necessary to bear in mind the course of the terminal branches of the vasa vesicalia superiora et media. A horizontal or an oblique incision should be made, depending upon whether the tumor is located in the fundus of the bladder or in the neighborhood of one of the ureters.

An assistant then passes his finger into the rectum and pushes upward into the level of the wound that portion of the bladder, upon which shall be performed the extirpation of the tumor and the resection and suture. This is generally not difficult, since after further incision of the ligamentum arcuatum inferius, the root of the penis may be easily displaced anteriorly as far as necessary. It is superfluous to resect the horizontal and descending rami of the pubis further laterally from the root of the penis.

For the normal healing of the bladder wound it is desirable to keep that organ as dry as possible for two or three days. This

can be accomplished by means of permanent catheters in the ureters. It is best to use catheters with terminal openings, and they need be passed only a short distance into the ureters. It is also advantageous to inject once or twice daily into the catheters a small amount of a 1/10-1 per cent. silver nitrate solution. In addition to the ureteral catheters a Nelaton catheter should be introduced into the bladder.

That fistulæ occur so often after the bladder suture (adaptation Lembert sutures) is to be explained by the anatomical conditions present. It is especially inadvisable in these bladders with thickened rigid walls to introduce a further "invagination suture," since the Lembert must thus necessarily become stretched, loosened and insufficient. In addition, the invagination suture is entirely useless, since here on this extra peritoneal portion of the bladder wall we have to do with only the prevesical fat, or if we dissect this away, only the muscle layer; in short, tissues, which, if coapted by invagination, show (in contrast to the serosa of the stomach and intestines) absolutely no tendency to a fibrinous adhesion and union. The aim here must be, therefore, to attain such healing of the wound surfaces as shall produce within two or three days a firm union over a given area by means of budding and branching of the blood vessels. Therefore in these cases with hypertrophic and rigid bladder walls, where the predisposition to fistula-formation is especially great, a curved incision should be made through only the outer half of the bladder wall, this outer layer then dissected back, either bluntly or by sharp incisions, in the form of a flap and retracted. An opening into the bladder is then made in the middle of this surface by means of a sharp straight incision. This incision in the inner layer of the bladder wall, which is soft and pliable, and therefore suitable for invagination, may be permanently closed by suturing in two or even three layers. In this method of invagination broader surfaces are brought into contact with each additional layer of sutures and the best chances for healing are afforded. Finally, the flap made from the outer layer of the bladder wall is sutured back in its original position, and adds from this protection to the invagination sutures.

The symphysis is then fixed in place by means of two silver-wire sutures on either side and the rim of the arcus pulis united to the surrounding bony structures by means of silk sutures

through the periostium. The incised lig. suspensorium is then repaired and the two slit-like openings in the fascia transversa closed. The vasa deferentia are now replaced in the inguinal canals and these closed by suturing the aponeurosis of the external oblique. There remains now only the skin incision to be closed.

III. Total Extirpation of the Urinary Bladder with Double Lumbar Ureterostomy.

T. ROVSING (Copenhagen). A total extirpation appears to be indicated in many cases of extensive diffuse malignant growths. While up to the present time only about 30 such operations have been performed, this is undoubtedly due to the high primary mortality (over 50 per cent.) of the procedure. This high mortality is not due so much to the actual danger of the extirpation, as to the difficulty in caring for the cut ends of the ureters, in such manner as to prevent the subsequent urinary infiltration and infection of the wound cavity.

The methods which have been used up to the present time in the care of the ureters, are for the main part the following three: 1. The ureters have been left lying free in the floor of the large wound cavity (Bardenheuer, Kümmel). 2. Implanted in the rectum (Maydl) or in the flexura sigmoidea (Wilms and others). 3. Implanted in the vagina which is then closed by calpocleisis.

The great mortality and the disagreeable features attendant upon the above-mentioned methods (urinary infiltration, ascending infection of the kidneys from the rectum, etc.) have induced me to seek a new path for the exit of the urine. Since the results of my three operated cases have encouraged me to continued attempts, I allow myself to present this method for your worthy consideration. Concerning first the extirpation of the bladder, I generally perform the operation without opening that organ after the manner of enucleation of a cystic tumor, proceeding as follows: The bladder is first injected with 200 c.c. of an antiseptic fluid and the patient put in the Trendelenburg position. Good access to the bladder is gained by a curved incision, convex downward, with partial separation of the insertion of the Mm. recti. The vertex and lateral portions of the bladder are now separated

from the surrounding loose connective tissue by means of double ligation and incision of the firm vascular connections; then, if possible, the peritoneal covering is separated carefully from the posterior wall of the bladder; if, however, the peritoneum is adherent to the infiltrated bladder wall, then the peritoneal cavity must be opened and the organ removed with its serous covering. The ureters are severed 1–2 cm. from the bladder, cutting between double ligatures. In female individuals it is now only necessary to separate, by blunt dissection, the neck of the bladder and about 1–2 cm. of the urethra, clamping these off with a narrow augiotrihi and severing peripherally. In male patients the process is more complicated. Here the prostate and base of the bladder must be carefully separated from the rectum. The pars memb. urethræ which is now exposed, is drawn out in the form of a pedicle, and severed after first applying a narrow hemostat peripherally. This clamp remains in place 24 hours in order to prevent hemorrhage from the cavernous tissues. It is thus possible to complete the bladder extirpation as a practically bloodless operation. If the peritoneal cavity has been opened and the serous covering removed with the bladder, it is now closed by means of a transverse a Mikalicz drain, which consists in spreading out a large piece of gauze in the wound, and filling it with strips of the same material. The whole is brought out through the centre of the wound. I always saturate the gauze strips with a 1–2 per cent. silver nitrate solution. The recti muscles are now sutured with aluminium-bronze sutures and the skin-wound closed.

After this operation, which lasts from one-half to three-quarters of an hour, short lumbar incisions are made on either side, extending laterally 8–10 cm. from the border of the *M. erector spinæ*. Each ureter is now sought out by palpation just below the pelvis of the kidney, and brought forward into the wound by hooking a finger about it. It is now separated cautiously by means of blunt dissection with the finger down to the ligated end and drawn up out of the wound. We now have both ureters hanging free from symmetrical points in the triangle of Petit, each about 8 cm. from the median line. The lumbar incisions are now sutured. In my first case, I immediately cut off the ureter, flush with the skin suturing the tunica fibrosa to the fascia and the mucosa to the skin. Funnel-like retractions of the ureters took place in this case and I have therefore modified my

technic in the later cases; I do not fix the ureter at all but leave it hanging down entirely free in a glass receptacle, after inserting a No. 12 rubber catheter, until its end is just past the level of the abdominal wound. Externally the ureter is drawn through a perforated rubber finger and thereby protected. The ureter now heals in the wound and the free dependent portion shrivels up and becomes necrotic to within 2-3 cm. of the wound. When the lumbar wound is healed at the end of 8-14 days, the necrotic portion is excised, while the living portion projects as a small beak-like urethra above the skin level and is soon covered externally with epidermis.

From now on the catheter is not introduced, and the free passage of urine is provided for by means of a bandage, made according to my design by the firm of Svenssen and Hagen.

The bandage consists in a broad elastic girdle, in which are sewed two silver plates each with a circular opening into which fits exactly a flat silver capsule which collects the urine. Attached to this silver capsule and passing over the border of the plate is a flattened silver tube, and from this a rubber tube, through which the urine passes to a urinal below the symphysis. On the urine side of each silver plate is a circular rubber ring filled with air, which, by means of the bandage is pressed firmly against the lumbar region about the opening of the ureter. By means of this bandage worn day and night for 11 months, my first patient was able to keep absolutely dry. R. demonstrated a bladder removed from a 34-year-old single woman. The entire mucous membrane was changed into villous masses, and the entire posterior bladder-wall was so infiltrated with the tumor masses that it had to be removed with its serous covering attached. For 6 months she had suffered from constant profuse hematuria and constantly increasing tenesmus, and upon admission to the clinic was most miserable, anæmic and had lost much flesh. Cystoscopy was impossible on account of the hematuria and tenesmus. After dilatation of the urethra ad modum simon, a digital exploration of the interior of the bladder was undertaken, and it was determined that the entire mucous membrane had been changed to tumor masses.

Total extirpation of the bladder with double ureterostomy performed on May 3, 1906. All three wounds healed well, but stay in bed was materially lengthened by the development of a

thrombosis in the left vena femoralis. Since then the patient has improved rapidly, gained 30 pounds, feels well, and is able to work. The bandage acted to her entire satisfaction so that she remained dry day and night.

Twice since then the author has had occasion to perform the same operation upon male patients, both in the university clinic.

The first case is that of a 67 year old man, who was operated upon September 6, 1906. He had two cancerous papillomatous masses in the bladder, one of which had invaded the entire region about the left ureter, while the other had infiltrated the vertex and collum vesicæ, in all the layers. Extirpation without hemorrhage and peritoneal cavity not opened.

As had been expected, the left ureter was markedly dilated and the left kidney, hydronephrotic, the right ureter normal, but the right kidney entirely atrophic, a condition which had not been suspected. The wound healing was normal but the patient became uræmic on the eighth day and died in coma.

Cause of death determined at autopsy to be due to double renal atrophy and myocarditis. It was interesting however to note that not the trace of a metastasis could be found, a fact which should encourage us to renew our efforts and constantly seek a radical cure for these cases of vesical and prostatic carcinoma.

The third preparation was from a 57 year old man, upon whom R. had operated four weeks previously. It was possible here to extirpate the bladder unopened in conjunction with the prostate and the pars prostatica urethræ; fortunately, for one can see from the preparation, that not only is the major portion of the bladder infiltrated with an encephaloid carcinoma, but the Pars prostatica urethræ shows already small tumor masses. This patient also withstood the operation, especially well and at the present time feels perfectly normal. His kidneys act in a satisfactory manner, so that a radical cure, in his case, depends upon whether he also is free from metastases.

The advantages which my mode of operation appear to me to possess over the former methods are the following: 1. A completely aseptic bladder extirpation is possible, since urinary infiltration and infection from feces are impossible. 2. There is thus prevented the great danger of a secondary ascending infection, which is always possible when the ureters are implanted in

the rectum *S. romanum* or vagina. 3. In female individuals this method has the advantage over the vaginal implantation of Pawlick, that the genital sphere and functions of the woman are undisturbed.

Perhaps this operation may be indicated not only in malignant tumors, but also in the severer forms of *ectopia vesicæ* and also in ascending uro-genital tuberculosis.

BOOK REVIEWS.

AMERICAN PRACTICE OF SURGERY. A Complete System of the Science and Art of Surgery. By Representative Surgeons of the United States and Canada. Editors, JOSEPH D. BRYANT, M.D., LL.D., and ALBERT H. BUCK, M.D. Complete in Eight Volumes. Profusely Illustrated. Vols. I and II. Wm. Wood and Co., New York, 1907.

There are two ways now a days of writing a medical book, single handed or in a sort of literary partnership. When a man eminent for experience in learning and in works writes a treatise on his chosen subject, he makes his volume the record of his own achievements and a measure of his own knowledge. According to his ability as a teacher and the lucidity of his style as a writer, such a work becomes valuable as a text book for medical students or a handy reference volume for the desk of the busy practitioner. The scope of such work must always be limited since the table of contents is measured by the horizon of one life. They reflect, however, far more clearly the personality of their authors and have an individuality and charm which must always be denied to the more pretentious "system" which one might call the orphan asylums of medical literature. Nevertheless, the systems with many parents have far more potential energy than the volumes which own but one paternity, where in fact the chapters are often fragmentary and suggestive rather than complete, and provide an emergency ration rather than a full meal. Medicine and Surgery at the present time have become so highly specialized that it is impossible for any one mind to master the subject or even to be fairly proficient in all its branches sufficient for the needs of the individual if he has a working knowledge of his chosen field and the means of enlightenment where the vastness of the field has left him bewildered and astray. It is just here that an eight volume treatise supplements the defects of the shorter works written by individual authors. It is their part to give the full measure of knowledge required by the earnest worker by grouping together in

a harmonious whole the differing but kindred subjects which together make up the complex fabric of modern medicine or surgery.

This it is, which is the *raison d'être* of the system with its editors, collaborators or separate authors. Each subject in a system of surgery should be exhaustively treated, but it is precisely this which requires that the work should be apportioned among different men, each author a man who has largely devoted his life to his subject and therefore best qualified to write exhaustively because of special knowledge and special opportunity. On the other hand, a work of this character, unless judiciously edited may be badly balanced, with chapters of unequal merit and learning and style so motley that while we appreciate the business acumen of the publisher, nevertheless we are compelled to sympathise with the editor. Of the present system no one to whom the senior editor is well known will venture to predict such a quality. His reputation for learning and decision forbid us to anticipate in these volumes anything save the best that the profession of this country can offer. Nor are we disappointed as we review volumes I and II now in print.

Volume one is largely devoted to the discussion of what may be termed the basic facts of surgery. The introduction is an interesting chapter by the venerable Stephen Smith on the history of American Surgery. When a man of 86 years of age, the Dean of American surgeons discourses of the history of the art in this country we can say of him what his modesty forbade him to say of himself "Magna pars fui."

The chapter is largely one of personal reminiscences and therefore of twofold interest. The chapter on inflammation sets forth the modern view of what the older surgeons regarded as a disease in itself, when it defines the process as one which is adaptive, protective and reparative. In a few words this sentence states the difference between the older pathology and the new. Chapters follow on disturbances of nutrition, on certain special infections and on tumor formation. There are two points of view from which we may regard the facts of tumor formation, the purely pathological and histological and the clinical and experimental. The chapter on the histology and theory of tumor formation treats the subject from the first standpoint with almost the completeness of a special work. Cohnheim's theory is re-

spectfully spoken of as "the most brilliant hypothesis concerning the origin of tumors ever advanced." Why a hypothesis which has absolutely failed to explain the *cause* of the overgrowth should be so characterized is an enigma. A hypothesis is valuable alone in proportion as it explains and accounts for certain facts and in medicine or surgery offers us a scientific basis for therapy. In cancer it is not so much the character of the cells which concerns us as their overgrowth and the toxæmia which the disease produces irrespective of mere nutritional disturbance dependent on a disturbed function mechanically interfered with. The difficulty with the "brilliant" theory of Cohnheim and other kindred, is that they concern themselves with the character of the cells but not at all with the most vital problem of cancer, the cause of the overgrowth. No theory which loses sight of this factor in the problem deserves commendation. Such theorists have been but blind leaders of the blind. Up to the present time they have offered us no basis for rational therapy nor have they taught us how we are to live so as to avoid the disease. When we turn to the clinical and experimental method of investigation we may at least bid ourselves hope. What surgeon is there who has not met with utter defeat in his attack on this most fiendish of diseases? Who is there who has not seen his patient succumb either because the disease was inaccessible surgically or in spite of the most painstaking and radical work? We all mourn our defeats which alas outnumber our victories. We used to think the three year limit safe. Now we have been obliged to advance it. Says McCormick of England, "Call no woman cured of cancer until she is dead." Baldy states that less than 5 per cent. of cases of cancer of the cervix are cured. Yet no phase of the disease has been the subject of more persistent and careful attack. What comfort is there for us after all in Cohnheim or Ribbert? They leave us where they found us, in the mire of defeat and hopeless defeat. No surgeon, however, can read this chapter of Gaylord's without a reawakening of hope in his heart. If tumors known to be malignant can be transplanted with 100 per cent. of successes in animals this fact in itself is sufficient to remove us from the benumbing influence of purely histological theories. Gaylord may not have discovered the cause of cancer, but his work and that of others working along similar

lines has done much to rid the atmosphere of dense mists and shadowy hypothesis. If in addition it can be shown that some mice recover from the malignant mice tumors and that such mice can never again be successfully inoculated and that the sera of such mice has an inhibitory effect on the tumors of non immune mice, experimental pathology will have done much to furnish a sound basis for therapy. Let it once be established that cancer is contagious and the incidents concerning infected cages related by Gaylord seem to warrant such a supposition and we shall have advanced a long way toward the solution of the problem. As we read Gaylord's account of his work in the Buffalo Laboratory for Cancer Research we cannot but feel encouraged for the future and we confess to a feeling of admiration and sympathy for the tireless workers who pursue their quest undismayed and undisturbed despite much unfriendly and some unjust criticism. May they reach their goal! The chapter on Surgical shock will disturb many old notions as to the efficacy of remedies which all of us have used in this condition. It is to be regretted that we are not offered anything very tangible in exchange. The chapter on general surgical diagnosis is the fruit of close observation and wide clinical experience. It is a monograph which ought to be put into the hands of every medical student when he graduates.

The increasing importance of the Röntgen ray both from the diagnostic and therapeutic standpoint is emphasized by the length and excellence of the chapter devoted to its consideration. Of especial importance is the section devoted to its interpretation.

Volume two opens with a chapter on the surgery of what may be termed the tropical diseases. It also treats of anthrax, glanders and actinomycosis. Other chapters follow on the surgical disorders associated with syphilis and tuberculosis, those twin spectres which accompany poor humanity from the cradle to the grave. Other chapters treat of the surgical disorders of the skin, muscles, tendons, nerves, lymph nodes, etc. Burns produced by the electric current are dealt with in a special chapter and the volume concludes with a long and informing chapter on bullet wounds. The reader is here given the latest knowledge possessed on this subject by an expert who has been familiarized with the effects of modern high powered projectiles by actual service. Space forbids more extended discussion of individual

chapters. All are written by men who are authorities in their specialty. Much of the matter is new and all of it valuable.

The editors are to be congratulated on their work. They have chosen their collaborators wisely and have together wrought a work which is a credit to the science and art of Surgery as practiced and taught on this continent.

ALGERNON THOMAS BRISTOW.

A MANUAL AND ATLAS OF ORTHOPEDIC SURGERY. By JAMES K. YOUNG. P. Blakiston's Son and Co., Philadelphia, Pa.

This very comprehensive work exhibits the result of the extended experience of the author and also a studied presentation of the subject. The arrangement is a logical one and the text very readable. The selection of illustrations in this as well as in many other treatises of the present day is open to criticism. Although a great advance has been made by substituting artistic photographs for crude drawings, yet it would seem that too much space is sacrificed for a finished product of art without a sufficient teaching value to compensate for the increased bulk of the volume. Another frequent fault of the medical illustrator is the depiction of the extremes of deformity and disease. What the reader wants is an aid to early diagnosis—such as the author gives in some of these pictures of attitude in spinal caries. The book is profusely illustrated and the illustrations are well done, in fact the whole work is a good example of the printers art. It is well worthy of a place in the library of the general practitioner as well as the specialist.

After an opening chapter on the history of the subject, the author takes up the general etiology and pathology of deformity, with its symptoms and diagnosis, all of which are most instructive. Considerable space is then given to prophylaxis and general treatment in which is concisely stated the different methods employed for mechanical support and forcible corrections. A chapter is devoted to tenotomy with a brief outline of tendon and nerve transplantation.

The chapter on Potts disease is comprehensive with all points well illustrated. In the treatment of abscesses, however, the author hardly lays sufficient stress upon the value of the expectant or conservative side. Following the discussion of tuberculosis

of each joint, the non tuberculous affections are well covered. The subject of hip disease is also thoroughly gone into with a discussion of the various methods of treatment. Most of the chapter on non tubercular disease of the hip is devoted to coxa vara, that condition receiving fuller treatment than in any other orthopedic work except Whitman.

Lateral curvature receives the extended discussion which it demands. Not as much space, however, is given to the surgery of paralysis as the comprehensiveness of the treatise would lead one to expect, but otherwise the varied forms of paralysis are carefully explained and illustrated,

The subject of acquired valgus or weak foot receives too little attention considering the prevalence and importance of this disability—no mention being made of the Whitman arch support. Much greater space is devoted to congenital dislocation of the hip which is instructively dealt with in diagnosis and the different operations for reduction.

Although many criticisms have been made, yet this manual of orthopedics will be found of great interest and value, of help to the physician as well as the student of Orthopedics.

CHALDS DWIGHT NAPIER.

PRACTICAL GYNECOLOGY. A Comprehensive Text-book for Students and Physicians. By E. E. MONTGOMERY, M.D., LL.D. Third Revised Edition. Philadelphia: P. Blakiston's Son & Co., Publishers, 1907.

In the preface to the first edition of this work (under date of August, 1900), the writer states that the work has been under consideration for fifteen years and much of it had been rewritten several times. An effort was made "to make it a comprehensive work upon the subject, giving the experience and methods of the most careful men, while my own experience has been utilized to indicate that which I have found most useful and worthy of acceptance."

In the second edition, appearing in 1903, such changes were made as are necessary in the natural growth of the subject and, as from experience with the previous edition, the author thought would prove of benefit to the student.

The present edition represents another careful revision of

the subject, paying special attention to microscopic diagnosis, gynecic bacteriology and the pathology of uterine cancer.

One of the best features of this work is that each general subject, as far as feasible, is considered with reference to its influence upon the entire genital tract, thus giving a more comprehensive view of each subject than when each organ and its diseases are studied separately. This work has been and still is one of our best text-books and we welcome the present edition.

J. A. SAMPSON.

- I. DIE BEHANDLUNG DER TUBERKULOSEN WIRBELSAULEN-ENTZUNDUNG, VON DR. F. CALOT, uebersetz von DR. P. EWALD.
- II. DIE BEHANDLUNG DER ANGEBORENEN HUFTGELENKSVERRENKUNG, VON DR. F. CALOT, uebersetz von DR. P. EWALD. Stuttgart. Ferdinand Enke, 1907.

I. This translation has retained much of the vivid and picturesque style of the original brochure. The book deals with the treatment of the Kyphotic Spine of Potts Disease. Calot believes that merely the gibbus of small extent may be straightened. This is to be accomplished by "redressement." After describing the manner of applying a plaster jacket from the neck to the trochanters, embracing the chin and occiput when the gibbus is higher up, the method of "redressement" is detailed. A fenestra is cut out of the plaster jacket to correspond to the gibbus. Over this several pads of cotton are placed to exert a moderate pressure. At the expiration of every 14 days the pads are renewed and their number increased until the deformity is obliterated. The pads are held in place by circular turns of dextrine bandage. A feature of this "Calot jacket" is its construction out of large layers of dextrine gauze, steeped in plaster cream, which are moulded to the form. A large window is cut out of the front of the jacket. Emphasis is placed upon the necessity of extension—but not suspension—in applying the jacket. To some extent the case is passed upon as healed by the alignment of the spinous processes in the radiogram. A jacket is worn five to six months and is then renewed or a celluloid corset, moulded to the cast made from a model of a plaster jacket. Calot is very enthusiastic in his recommendations of the injection of iodoform-oil and camphor naphthol for the treat-

ment of cold abscess and sinuses in connection with spondylitis. The iodoform is preferred for the well defined abscesses, the camphor naphthol for those in a fungating condition. As many as a dozen injections are made at intervals of a week.

For the complication of paralysis Calot recommends no treatment other than a well fitting plaster jacket.

The instructions are so explicit and the illustrations so numerous and well represented that it should be an easy matter for the practitioner to acquire this technique.

II. The original of this work appeared in the French language. It was so replete and exacting in its detail, and based on a practical application in so large a number of cases (443), that it suggested itself to Dr. Vulpius that it would be very desirable to possess a German translation to supplement the German writers on Bloodless Reduction of the congenitally dislocated hipjoint, who were the pioneers in this method!

The two introductory chapters are devoted to the early diagnosis of congenital dislocation, emphasizing a scrutiny in the gait, examination in the erect and recumbent posture. Acquired forms of dislocation due to traumatism, osteomyelitis, typhoid fever, and paralysis, are differentiated by the history of their onset. The prognosis is hopeless in untreated cases. Children under 7 years of age, if properly treated, are always cured. Between the ages of 7 and 12 a cure can be effected in 90 per cent. of the cases, wherefore reposition is always to be attempted. In children between the ages of 12-15 reposition is possible in three out of every four cases. Beyond the age of 15, reposition is difficult and possible occasionally if preceded by a long period of extension. In bilateral dislocations the age limits of reposition have to be lowered by two to three years. Emphasis is placed upon proper "Reposition." If the latter has been effectively done, we have at the present day means at our disposal to maintain the reposition.

The remainder of the book is divided into two parts. Part one is given to a consideration of the technic of reposition embracing the manœuvres, the application of the plaster of Paris bandages, and the after treatment. It is possible if one is very accomplished in the technic, and certain of reposition to effect a cure with a simple application of a plaster of Paris bandage. A better control of the position is possible by a reapplication at the

end of two months and for similar reasons a third-bandage is to be applied.

The after treatment embraces correcture of the thigh, the position of the kneejoint and the lordosis. Active motions alone are to be relied on to restore mobility of the hip. The muscles to be strengthened by massage.

If a relaxation is encountered anteriorly, a new reposition with flexion of 60° and 30° – 50° abduction is recommended; for posterior relaxations an abduction of 90° is necessary.

The second part of the book is devoted to a consideration of the various chemical forms of the unilateral and bilateral dislocation.

In speaking of the results in the 15th chapter, author claims 100 per cent. cures in the last 100 cases. In children beyond 10 years of age who are treated a rigidity of the joint may result and even where transposition follows reduction a better functional result is obtained. Severe relaxations are not to be encountered if the technic of forced abduction and hyperextension advocated by Germans is abandoned. Without fear of exaggeration in the early-treated cases, one can speak of a "radical cure" as does the surgeon in the radical cure of hernia.

The significance of radiogrammes is thus stated. The Röntgen rays have contributed to the development of the technic, so that we can now apply the technic without having refuge to the X-rays at all times in the average case.

The concluding chapter covers the operative treatment of cases not amenable to reposition. Hoffa's operation is passed upon as being a formidable procedure with but moderate success at the best. Senger's operation is regarded as less severe, but the reposition is incomplete. Calot characterizes his open operation of small incision and dilatation of the capsule with subsequent reposition of the head as being on a par with tenotomy in all other respects like the bloodless reduction.

The concluding chapter embodies the palliative treatment of irreducible dislocations. Either with the aid of orthopedic appliances or by successive application of plaster of Paris spicas the gradual correction in whole or in part is effected.

The aforesaid is an epitome of the narrative embodied in the 271 pages of this book. It has been the author's aim to outline the treatment with all the precision it requires, so as to

be available for the practicing physician. In this respect, the work is far too comprehensive. The 206 illustrations afford a most graphic presentation of every manipulation, and the radiographs are of the best. A translation in the English language of this practical monograph is devoutly to be wished.

MARTIN W. WARE.

GYNECOLOGY AND ABDOMINAL SURGERY. Edited by HOWARD A. KELLY, M.D., Professor of Gynecologic Surgery at Johns Hopkins University; and CHARLES P. NOBLE, M.D., Clinical Professor of Gynecology at the Woman's Medical College, Philadelphia. Large octavo; 851 pages. Philadelphia and London. W. B. Saunders Company. 1907.

Volume I of this treatise is a marked addition to the literature of its subject. While it shows forcibly the intimate relationship between gynecology and abdominal surgery, it tends to demonstrate still more forcibly that gynecology is simply a branch of general surgery and should always be considered as such. The editors in their preface call the general surgeons their "competitors, and generous critics," and say that "they (the general surgeons) will not deny that the great advances made in the gynecologic field have constituted the very backbone and the marrow of the abdominal surgery of to-day." No doubt those who have at first devoted themselves exclusively to operations upon the uterus and adnexa will view the field from this standpoint, but, as in the present case, it is often these very men themselves who have seen the narrowness of their field and have rapidly reached out, claiming the bladder, the rectum, the ureters, the kidneys, the appendix, and even the diseased breast, as within the field of gynecology.

In one of the greatest and most brilliant books of recent date upon the subject of Operative Gynecology, there appears a chapter on the Radical Cure of Hernia and a chapter on Intestinal Suture. Is this not abdominal surgery? It is evident that the surgeon must first become proficient in general surgery before he devotes himself to gynecology. Gynecology has become what it is to-day because general surgeons have entered on its domain.

The present work is edited by Howard A. Kelly of Baltimore and Charles P. Noble of Philadelphia. The various chap-

ters are written entirely by American authors. Three of the collaborators, Drs. Alexander J. C. Skene, Wm. R. Pryor, and Ferdinand Henrotin, have died during the preparation of the work.

The first volume is devoted strictly to gynecological subjects. There are many interesting features. The chapters on the bacteriology and pathology of gynecology by William Ford and Elizabeth Hurdon are the most extensive that have yet appeared on the subject. There is a chapter devoted entirely to medical gynecology which is a fitting compliment to the surgical considerations. The remainder of the book takes up in detail gynecologic technique and gynecologic operations. In a number of instances where differences of opinions concerning the relative advantages of the abdominal and of the vaginal route for the performance of operations have existed, advocates of each side have been chosen to write upon the subject.

The book is most elaborately illustrated, every illustration having been specially made either by Hermann Becker or Max Brödel, whose work has yet to find their equal. They are anatomically accurate and beautifully executed.

PAUL M. PILCHER.

CORRESPONDENCE.

SUBSEQUENT REPORT ON A CASE OF SEVERE SPINAL CORD INJURY, SYMPTOMS OF COMPLETE SEVERANCE OF THE CORD.

EDITOR ANNALS OF SURGERY:

In the November, 1906, number of the ANNALS, I reported a case of dislocation of vertebræ in the lower cervical region, followed by symptoms of complete severance of the spinal cord. The operation of laminectomy was performed by Dr. Roswell Park of Buffalo, fifteen days after receipt of injury, and at the level of the 6th cervical segment the cord was found to be flattened so that it did not nearly fill the canal. There was a small remnant of an old clot within the dura. On lifting the cord with an artery needle, it seemed flattened, ribbon-like, shrunken, and to lack in bulk. The patient made a slow, continuous improvement, able to move the feet a little, and considerable improvement in sensation; in the hands and arms not much change appeared. He left the hospital about four weeks after the operation. Considerable later improvement is evidenced by the following letter received on August 8, 1907.

WELLSVILLE, N. Y., Aug. 6th, 1907.

DEAR DR. KRAUSS:

I thought I would write you a few lines and let you know that I am working again at my old trade (operator). I am back in the office and can do the work all right now, does not tire me hardly any, and am feeling fine.

I seem to be gaining right along, but of course it is very slow. Cannot get around alone, but can get around the house with help of some one, just enough help to steady me. Cannot hold balance well enough to go alone, but have walked ten or fifteen feet alone by using cane.

The continued improvement in the case is sufficient evidence to prove the advisability and necessity of operation in cases of spinal cord injury, even if the reflexes are totally absent, the bladder and rectal sphincters paralyzed, complete loss of motion and sensation, and even with a moderate degree of cystitis and beginning bed sores present.

WILLIAM C. KRAUSS, M.D.,
Buffalo, N. Y.

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